



COLONY AND PROTECTORATE OF KENYA

**DEPARTMENT OF AGRICULTURE
ANNUAL REPORT
1950**

VOL. II

1952

PRINTED BY THE GOVERNMENT PRINTER, NAIROBI

Price: Sh. 7/50



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ANNUAL REPORT OF THE PROVINCIAL AGRICULTURAL OFFICER, NYANZA PROVINCE, 1950

Seasonal Conditions

The long rains were good, and, in many places, notably in most of South Nyanza, early. The higher parts of Kericho and the Highlands Division of South Nyanza had exceptionally heavy rain. The early part of the year was thus the exact opposite of 1949. The short rains, wherever they normally occur, were poor or failed entirely. The year ended with a comparatively severe drought nearly everywhere. There was little hail, except around Kericho.

RAINFALL

	1949	1950		1949	1950
	<i>inches</i>	<i>inches</i>		<i>inches</i>	<i>inches</i>
NORTH NYANZA:			KERICHO:		
Kimilili ..	—	54.28	Kericho ..	74.28	78.48
Nambare ..	52.03	80.20	Muhoroni ..	43.35	51.51
Kakamega ..	62.34	78.82	Sotik Post ..	—	32.92
Bukura ..	50.59	62.94	Jebelot ..	—	48.13
CENTRAL NYANZA:			SOUTH NYANZA:		
Malanga ..	54.53	55.52	Kisii ..	59.91	63.80
Bondo ..	34.66	29.16	Suna ..	36.62	41.07
Ahero ..	36.58	46.89	Muhoro ..	18.27	19.66

Production

CROPS: AFRICAN AREAS

With the exception of maize, production was equal to, or in the case of rice, cassava and cotton, is expected to have exceeded, that of 1949. The saleable surplus of millets was low because large quantities are believed to have been stored by producers of their own free will, as a reserve in the event of invasion by locusts. Crop production was, and will be for a long time to come, comparatively far greater than animal production, even in those areas of the Province which are suitable for livestock husbandry; but it is hoped that, as the lessons being taught gradually sink in, the emphasis will be more and more on livestock.

Cassava.—Intensive propaganda resulted in a great increase in acreage. The effect of mosaic was not of economic importance. In a few places water-logging caused heavy losses. Cuttings were distributed in South Nyanza and the Southern Division of North Nyanza. Cassava was introduced in the Kano for the first time. Planting material in large quantities was supplied to other Provinces.

Arabica Coffee—South Nyanza.—The change-over from block to individual plantations was fully justified by the higher standard of cultivation which resulted. This was not achieved without recourse to the threat of legal proceedings because of bad husbandry. Couch grass is perhaps the major problem; there is no doubt that the re-introduction of shade and the use of mulching is helping greatly to eradicate it. Pruning and stumping demonstrations were given to planters who, themselves, as forecast in the last report, would be carrying out those operations for the first time. It is noteworthy that those growers with fewer trees have, on the average, produced a product of higher quality than those with a greater number of trees. The Department continued to be responsible for propagation. There was a fairly heavy infection of leaf disease and of coffee berry disease, the latter in the higher areas. These infections necessitated a higher proportion than usual of the crop being converted to Buni. Trees were dusted with pyrethrum

QUANTITIES OF PRODUCE MARKETED WITH VALUE TO PRODUCER

	QUANTITY		VALUE TO PRODUCER	
	Season		Season	
	1948/49	1949/50	1948/49	1949/50
	tons	tons	£	£
AFRICAN GROWN—				
Cassava	178	1,435	995	7,625
Seed Cotton	4,300	4,245	130,486	142,778
Ground nuts	1,237	1,730	20,704	34,769
Maize	72,092	142,742	452,161	952,474
Finger Millet	1,386	2,298	13,577	22,520
European Potatoes	122	304	915	2,280
Pulses	770	505	—	—
Rice	1,577	1,336	21,132	18,643
Sorghum	1,181	2,243	5,635	12,749
Wheat	104	165	1,337	1,609
Simsim	77	56	—	1,125
EUROPEAN GROWN—				
Wheat	140	307	2,520	5,572
Maize	1,814	4,197	19,954	54,823
Squatter Maize	1,232	2,024	13,553	23,376
Niger Oil (gallons)	25,293	27,450	6,723	6,713
Essential Oils (lb.)	3,105	6,855	9,045	20,565
Tea	4,052	4,718	—	1,233,279
Passion Fruit (gallons)	—	27,321	—	13,238
INDIAN GROWN—				
Sugar cane	65,223	99,540	—	44,509
Jaggery	1,565	979	—	14,650
Maize	606	446	—	7,488
Chillies	—	10	—	794
Rice	—	30	—	553

against antestia, of which there was very little. At the end of the year there were 789 growers with 144,459 coffee trees on 270 acres, giving an average of 182 trees per grower. The crop was the heaviest in local history. The figures given below show a considerable increase in production over the previous season; the 1950-51 figures are incomplete. The grading of the 1949-50 crop put 60 per cent into classes 2 to 4 compared with 41 per cent in 1948-49.

	Cherry	Parchment	Buni	Value to Producer
	lb.	lb.	lb.	£
1948-49	247,021	47,833	9,192	—
1949-50	201,747	33,061	5,198	2,587
1950-51	476,087	88,878	5,410	—

North Nyanza—Arabica Coffee.—A nursery was sown sufficient for planting 200 acres. Growth was so good that it was decided to plant out approximately 100 acres in 1951, to leave in the nursery seedlings for 100 acres of plantation in 1952 and to establish a new nursery at the end of 1951 for 1953 transplantings. The first plantations (between 300 and 400 in number) will be on the grey volcanic Elgon soil near Chwere and within a radius of 3 miles from the site of the first pulping station just below one of the new dams.

Cotton.—Following the cotton improvement drive very satisfactory results were achieved, cultivation, weeding and spacing being generally better than ever before. Good picking and grading, with the help of a dry end season, resulted in a cleaner crop than has been had for some seasons past. Acreage increase was not encouraged as it was considered that better production, within the limitations set by the strains grown, was more important. South and Central Nyanza were comparatively free from pests and diseases, but a fairly heavy attack of blackarm occurred in North Nyanza. The estimated yield of 8,000 bales will probably be exceeded, thus surpassing the two previous seasons.

COTTON PRODUCTION: BALES OF LINT

Ginnery	1948-1949		1949-1950		1950-1951	
	AR	BR	AR	BR	AR	BR
Malakisi	850	52	667	33	974	35
Nambare	1,062	17	1,093	20	1,476	45
Samia	2,882	217	2,809	173	—	—
Ndere	1,068	119	1,100	107	1,160	103
Kibos	—	—	—	—	179	38
Kendu	327	135	—	—	—	—
Homa	393	151	762	281	1,253	210
TOTAL	6,582	685	6,431	614	—	—
TOTAL AR and BR	7,267		7,045		8,594	

Our opinion, based on the result of trials, having been confirmed by experts, arrangements were made to replace BP 52 with S 47, in 1951, in the Malakisi, Nambare, Samia and Ndere ginnery areas, N 17 being retained for the present in the areas of the two southern ginneries, Kibos and Kendu. South of the Sondu in the Homa ginnery area, the intention is to replace N 17 with UK 48 when seed of that strain is obtainable in bulk. A trial will be done in 1951. With the introduction of S 47 and with the improved husbandry and picking now achieved, Nyanza cotton in 1951 and thereafter should be much improved.

Groundnuts.—One hundred and ten bags of seed were sold to cultivators by this Department in South Nyanza where an increase in acreage was achieved. Unfortunately, locally adverse weather conditions curtailed the yield. A small crop was also obtained in North Nyanza. With the new increased price, it is probable that there will be a substantial increase in production in 1951.

Leguminous grains.—The price of beans was increased to encourage production but too late to have an effect on long rains sowing. The price increase, together with propaganda and the importation of about 25 tons of seed, which were sold to growers, stimulated production in the latter part of the year and to a small extent helped to reduce the maize acreage. Locally bad weather conditions curtailed yield. No increase in the cultivation of other leguminous grains was recorded.

Maize.—The crop, apart from that in the Northern Division of North Nyanza, where it probably exceeded last year's, was less than the record crop of 1949-50. This was due to reaction after a heavy crop, the very early onset of the long rains in the Highlands Division of South Nyanza which caught many unprepared, the set back caused by early wet conditions, and the almost complete failure of more than half of the short rains sowings throughout the Province owing to drought. Despite this, it is estimated that nearly 100,000 tons surplus will be exported. In many regions the standard of cultivation continues to improve, particularly in the Northern Division of North Nyanza. As the cumulative effect of our campaign

for better land use becomes operative, our aim will be, not as in the past, a reduction in maize acreage, but a doubling or trebling of the yield off the acreage sown *without any harm being done to the land*. Let us not commit the common error of confusing mixed cropping with mixed farming; in those regions of the Province where alternate husbandry can be practised, the system should be based on improved cattle husbandry together with the production of maize and legumes or of some other staple crop, in places where climate is suitable and custom allows. Whereas in those parts of the Province which are suitable for maize growing our objective should be better maize culture through better land use rather than the negative one of reduction of maize acreage. It is an unwelcome fact that natives are attempting to grow maize in places which, on account of inimical soil and climatic conditions, are quite unsuitable. The trend in many of the lakeshore Locations exemplifies this. The steadily increasing price, together with the taste for maize (however undesirable dietetically) are responsible. Perhaps the best way of combating this tendency is intensive propaganda, which has already been commenced, on the relative profitability of the crops which can be grown.

Eleusine millet.—Some seed of selected Bukura *wimbi* was distributed in Central Nyanza. The acreage has, it is estimated, still further decreased. This decrease was accentuated in parts of South Nyanza where very early rain caught growers unprepared. Some damage by hail was reported.

Sorghum.—Some selected seed of Kano sorghum, obtained from Bukura, distributed in Central Nyanza. It is estimated that the acreage over all the Province was increased but the exportable surplus was comparatively small.

Potatoes (English).—*Phytophthora* blight reduced the yield of the early crop in the Highlands Division of South Nyanza. The late crop in the same Division suffered from lack of rain; in all, the South Nyanza crop was a partial failure. On the other hand, both the early and the late crop in Kericho (African areas) was good though there was a tendency for the late drought to have an adverse effect. In spite of heavy and continuous rain there was little blight. The aim in Kericho (African areas) is to make this more and more a short rains crop to take advantage of the higher price generally offered at the end of that growing season.

Rice.—Once again the North Nyanza crop did not come up to expectation. This is due to the facts that too much of it is still grown in places where an adequate water supply is just a gamble, that the majority is not transplanted, thus seriously reducing the yield, that there is continued lack of interest on the part of cultivators, and that a large but unknown quantity of it was lost by being attracted to Uganda by a higher price. In Central Nyanza production was increased from 3,000 bags in 1949 to about 10,000 bags in 1950. While most of the Central Nyanza rice is grown in the Kano, some success in introducing it in other lakeshore locations was achieved. It is noteworthy that all Central Nyanza rice is irrigated or is grown in swamps, that it is transplanted and that high yields are thus obtained.

Sesame.—No increase in production occurred in 1950 but an increase is hoped for in 1951 because it has been possible to announce a substantial price improvement before sowing time.

Sisal.—The bush sisal which exists, mainly along boundaries, in the Jaluo Locations came into prominence at the end of the year because of the increase in price and the introduction of licensed buyers and decorticators under the Control of Sisal in Native Areas Rules, 1950. The full story of this upstart native-grown sisal trade will be told in 1951 but even by the end of 1950 it was becoming apparent that hand-decorticated fibre of poor quality rather than leaf was being traded in far too much; consequently steps were taken to tighten up inspection at the premises of exporters. Another danger, the seriousness of which remains to be seen, is that, with easy money being made in this way, food crop and cotton acreages will be decreased.

Sweet Potatoes.—Sweet potato cultivation was increased, the imminent danger of locusts being in people's minds, but the increase was in ordinary *shambas* nearly everywhere and not largely along the roadsides of North Nyanza as in 1949.

Vegetables and Fruit.—The introduction of citrus fruits has been going on in a small way for many years; results are as yet hardly noticeable. The production of vegetables for the outside market is at present in a deplorably poor state. But the needs of the African's own diet, which too often now is an unhealthy one, must surely come first.

Wheat.—Wheat has been grown for some time in the higher country of Kericho (African areas) and in the Highlands Division of South Nyanza. In 1950 in both of those places its cultivation was extended. The next step is to try to get Africans to eat wheaten bread. To achieve that it is proposed to establish, with local funds, some bakeries in South Nyanza. In 1950 the previous very small acreage grown in the Northern Division of North Nyanza was substantially increased but is still small. Arrangements have been made for variety trials in native areas. Hand threshing machines are being introduced in Kericho (African areas).

Wattle.—A considerably greater quantity of bark was bought by the E.A. Tanning & Extract Co. Ltd., in the native areas of Kericho. That firm again kindly paid for a number of Assistant Agricultural Instructors there and in South Nyanza. More family plots were sown and there are now plots of all ages all over the higher parts of Kericho (African areas) so that there should be no break in annual sales which should progressively increase in quantity from now on. Five new buying centres were opened. In the Highlands Division of South Nyanza there were no sales in 1950 owing to the war-time gap in sowing, but sowing continued and the industry is being built up again. There was a drive to improve cultural treatment backed by local action under local by-laws. In Kericho (African areas) at the end of the year 120 tons of bark had been bought. Plans have been made for starting a small wattle industry in 1951 in suitable parts of the Northern and Eastern Divisions of North Nyanza.

EUROPEAN AGRICULTURE

Owing to the late 1949 sowing season, some Sotik farmers were still reaping maize early in March, 1950. Land meant to carry a second maize crop was therefore sown late. Rainfall was rather above average, until the last three months of the year, when, except in the Kericho region, a severe drought set in. As usual, hail did the damage, particularly to young tea, in the higher rainfall zone in August and September. The Lumbwa area, which can be very dry, had particularly good rain.

Barley and Oats.—A good acreage of barley mainly for pig feed, was again grown and some people tried it as a smother crop after breaking new land. Oats would probably be better for that purpose, and far more should be grown for hay. The crop of barley and oats for grain was good.

Coffee.—More old plantations in Fort Ternan and Songhor were brought into use again; some new plantations were begun in Koru, Fort Ternan and Muhoroni. The crop was heavy particularly in North Lumbwa, and from one plantation in Nandi.

Fodder Crops, Silage and Beans.—With plentiful grass around them, many farmers paid little attention to the need for dry-weather fodder production despite repeated warnings, which were made more urgent by the danger of locust invasion. A number of farmers grew edible canna.

Geranium.—This continued to be grown successfully in Lumbwa and was tried experimentally, together with peppermint and mint, in Sotik. This crop gives a substantial profit which should cover a limited price reduction.

Maize.—A fairly heavy crop was obtained but it was not so good on some farms in Sotik because of late sowing due either to the lateness of the previous harvest or to inexperienced farming. In Sotik the use of bad seed and subsequent

insect damage necessitated re-sowing in some cases. The lowest yield recorded in the year was 13 bags off 15 acres and was due to bad husbandry and waterlogging. A good farmer in North Lumbwa, on the other hand, recorded a yield of 38½ bags an acre.

Passion fruit.—The crop in Sotik was satisfactory. There was a good deal of woodiness disease but this disease need not be serious if growers do not try to keep a particular planting going for more than four years. The demand for the juice has decreased. The total acreage grown is about 400. Small areas were planted in Lumbwa and Fort Ternan. Bacterial blight and brown spot were also seen but diminished in the dry weather at the end of the year.

Sunflower.—Cultivation declined. The crop was good except in Songhor and Muhoroni, where a good deal failed because of late sowing and waterlogging.

Sisal.—With the increase in price the estates in lower Songhor and Muhoroni rapidly increased their acreage and began, in most cases, to improve the condition of their existing plantations. Two or three entered the leaf and fibre buying business in the native reserves.

Tea.—The crop was a good one despite some hail damage and the retardation of growth by wet and cold weather early in the year. The total acreage was substantially increased by new plantings. It is possible that the amount of tea manufactured has exceeded the output in any single previous season. A few small trial plantations have been established by people in Lumbwa, Koru and Songhor. Root disease caused some anxiety in Nandi.

Vegetables.—A few farmers, mainly around Songhor, have continued to grow vegetables, including tomatoes, for market and have had a not unsuccessful year. Their great distance from a really suitable market is against them.

Wheat.—Wheat is only grown in the higher part of Lumbwa. The average yield appeared to work out at eight bags an acre and upwards.

CROPS: INDIAN AREA

Maize.—A lot of the first sowings in Kibos—Miwani became waterlogged after heavy rain; some were resown. In contrast, Kibigori—Chemelil maize was seriously harmed by drought. So once again maize on the Indian farms was a failure.

Sugar.—With the help of the Machinery Pool the acreage was increased by about 10 per cent. Led by the factory estate, many farmers are planting better kinds of cane (C.O. varieties) and are thus making possible a considerable increase in the industry's output when other difficulties have been resolved. Growth of cane in 1950 was normal.

Livestock

One of the main problems in improving African farming is to find a good market for surplus stock, male, female, and culls. The main problem in Nyanza is to find an adequate market so long as the Meat Commission is unable to take much of this stock. Prices tended to rise during the year, ranging from Sh. 120 to Sh. 300 for cattle and Sh. 15 to Sh. 35 for sheep and goats.

SALES OF AFRICAN LIVESTOCK AND PRODUCTS, 1950

	Cattle	Ghee	Hides	Skins	Eggs	Poultry
	No.	tins of 36 lb.	No.	No.	Doz.	No.
North Nyanza ..	4,654	156	56,100	19,408	271,182	724
Central Nyanza ..	29,627	628	25,528	17,160	70,866	3,079
South Nyanza ..	44,725	17,215	10,721	14,034	52,622	238
Kericho ..	5,193	(a)	1,853	(a)	42,047	17,737
TOTAL ..	84,199	17,999	94,202	50,603	436,717	21,778

(a) Figures not available.

Production of butter fat was well maintained in the European areas on the good grazing afforded by the heavy rainfall, but the provision of supplementary fodder in the dry season was neglected.

Produce Inspection and Marketing

Although the principle of long-term storage at railheads in the producing areas was accepted, storage in the first half of 1950 and railway trucks, were not sufficient to permit the 1,600,000 bags of maize coming forward to flow evenly through markets. This necessitated periodical hold-ups of buying but the Marketing Officer and Maize and Produce Control finally successfully moved or stored the enormous crop. Marketing of the 1950-51 maize crop of about 1,000,000 bags had commenced smoothly at the end of the year. Cassava and rice were the only other crops to come onto markets in appreciable quantities; other produce being retained against a threat of locust invasion. The wheat crop was bought by the agents of the Kenya Farmers' Association. Except in Busia, all cotton ginneries were zoned and a great improvement in marketing resulted from the elimination of competitive buying. Coffee was marketed through the new growers' co-operative organization in South Nyanza. Large quantities of good quality eggs and ghee passed through markets..

CO-OPERATION

African maize marketing co-operative societies, the majority of which exist in North Nyanza (where there are three unions of them) continued to flourish. Maize marketing co-operatives are beneficial in that they aid orderly marketing and enable their members to obtain farming equipment more easily. The South Nyanza coffee growers' co-operatives were formed into a union at the end of 1949 and worked satisfactorily. The individual grower now takes responsibility for all cultural treatments and the co-operatives organization of the industry exerts a beneficial pressure on him. Ghee manufacture also is organized largely on a co-operative basis but particularly in South Nyanza where the societies are formed into a union.

Famine Prevention and Relief

The enormous quantities of food-stuffs grown by Africans particularly of maize, cassava and sweet potatoes, themselves were a safeguard against famine. No special measures were necessary. Continuous warnings about locusts insured a continuation of the production of cassava and sweet potatoes in 1951. No relief was required.

Improvement in Land Use

The limitation of cultivation with a view to the adoption of improved practical good rotation with a resting fallow, suitably supported by physical soil control and the manufacture and use of farmyard manure or compost according to the availability of cattle; has been encouraged by granting assistance from African Betterment Funds to those farmers who adopt these practices to the satisfaction of the district Agricultural Officer. Particular attention is being given to the methods of making manure and compost. Although the African District Council of Kericho and South Nyanza have supported these principles by legislation its enforcement is difficult outside focal areas. In new settlement schemes the proportion of land under cultivation can be controlled by settlement rules. But so far the granting or with-holding of A.B.F. assistance has provided the greatest incentive to the limitation of cultivation to from 50 to 25 per cent of a holding, according as to whether the area is suitable for alternate husbandry or is too dry, to applying soil control and to manuring.

The limitation and correct utilization and management of livestock are as yet difficult to put across to the African and can only be enforced in settlement schemes. However, a big advance was made in Central Nyanza by the district Agricultural Officer in co-operation with the Veterinary Department and in these locations no less than 26,492 bulls were castrated besides 5,310 sheep, 3,605 goats and 25 donkeys. In consultation with the householders, only the best male

stock were left to run with the herds. This should be helped when the breeding station of the Veterinary Department in each of the four districts can supply cattle and stud bulls to progressive Africans who have adopted good systems of management and the regular use of dips.

The rotational grazing of common pasture lands in Kericho is understood and accepted by the Kipsigis and is an improvement on the system of block closure, examples of which occur in all districts. A system of rough and ready paddocking has also gone far ahead in Kericho, and an attempt is being made to use this to improve the husbandry system there. Improvement in the stumping and weeding of pasture is to be desired. In Kericho also greater use is also being made of moveable night *bomas* in the higher rainfall zone. In the Jaluio areas, on the other hand, stock-proof hedges are being put round the cultivated lands of the village and it is hoped eventually that most land in a village will be demarcated into a vast two-course rotation.

In regard to farming systems, Africans in the areas of adequate rainfall are being encouraged to go in for ley farming; by advice, by assistance from African Betterment Funds, by the laying down of demonstrations at Bukura, Kakamega, Bungoma, Siriba, Kisii, Rapogi and Kabianga, and by the issue of good grass seed to reliable growers, the resultant seed crop being bought back for redistribution. Less progress can be recorded in the non-ley semi-arid zone which is fundamentally ranching or semi-ranching country, generally suffering from overpopulation and over-stocking where, in a primitive way, farming is at present too intensive. The proportion of resting grassland to cultivation must be high and manuring must transfer fertility from the pastures to the arable, this treatment being really an improved form of shifting cultivation.

First-phase group farming, i.e. lateral continuity of narrow base terraces, trash lines or uncultivated strips, of ploughing or cultivation and of cropping, was extended in the Upper Kano and South-Western Division of Central Nyanza and in the Northern Division of North Nyanza. Difficulties arise in consolidating holdings up and down slopes on account of variability in soil fertility. Where land is split up or irregular in shape, second-phase group farming aims to re-allocate family holdings so that each family retains the same size of holding but has a plot of equal size in each of the lateral fields of the group. At this stage the farmers of the group are encouraged to form themselves into co-operative societies to gain some security for agricultural credit. Progress is deliberately slow and their size must be manageable. Only four second-phase group farms were started in 1950 besides the four in the Belgut Division of Kericho. Such group farms do not require to be mechanized; they can be run by oxen just as well, and they can only become eligible for assistance from African Betterment Funds on their merits.

In many instances, owing to soil heterogeneity, individualism, and so on, it is preferable to encourage the development and improvement of consolidated family holdings and this is being fostered all the time by the officers of the Department.

The main work with trees has been the establishment of homestead plantations of trees, and wattle where appropriate, trees being sold from nurseries in nearly every location, financed from local funds.

EUROPEAN AREAS

All the European areas of the Province are hilly and require mechanical soil control and good land management to maintain their original levels of fertility. The land is generally suitable for good grade cattle and the practice of alternate husbandry. Most of it comes under the Cattle Cleansing Ordinance. A number of the better farmers have improved their grazing by the removal of buck, by fencing and by closer paddocking but they are still all too few as are those who undertake the preparation of farmyard manure. There is a need for dry-weather fodder provision in the form of silage, hay and fodder crops to improve the condition of

stock, thin milk yields and their live weight gains. Regular contact on sound farming methods was maintained by the Agricultural Officer (European areas) and the Assistant Soil Conservation Officer/Inspector.

The Lumbwa Soil Conservation Service Terracing Unit terraced arable land in the Lumbwa-Songhor area and tea lands in Kericho. Some badly drained farms were set out for "ridge and furrow" cultivation, while a number of tea estates undertook their own terracing. River scouts under the Assistant Soil Conservation Officer/Inspector laid out 6,000 acres on squatter *shambas* for soil conservation measures and a number of farmers' own line levellers were trained.

A shortage of labour is tending to make farmers rely too much on squatters. While a reduction of squatter stock is being attempted, there is over-grazing of farm lands in some areas, while in others farmers continue to rely too much on squatter maize cultivation.

Soil Control

The policy now adopted is to make use of uncultivated strips on land of up to 8 per cent slope in the higher rainfall areas, but not those at the highest altitudes, with single-volume narrow-base terracing above that slope percentage; to make use of trash lines on all slopes in high rainfall areas at the highest altitudes, where there are no white ants, and to use diversion ditches to intensify the effect of the trash lines; and, in the lower rainfall areas, to use double volume, narrow-base terracing on land having a slope of up to 8 per cent and single-volume, narrow-base terracing above that percentage of slope. In North Nyanza, terraces only were used in the past and control was inadequate and by no means universal. A drive, concentrated in two focal areas in each location in the Western and Eastern Divisions, to introduce uncultivated strips and terraces on steeper slopes was started right at the end of the year for the 1951 season. In the Northern Division, where previous work with uncultivated strips was excellent and widespread, that work was extended. In the Southern Division, in parts of which the best work with ordinary terracing had been done in the past, the use of uncultivated strips with terracing on the steeper slopes was intensified, particularly in the Bunyore scheme.

In Central Nyanza, apart from Gem Location, where uncultivated strips are being introduced, the previous year's terracing campaign was continued and intensified, double-volume terracing being used up to 8 per cent slope. The Central Nyanza Location Soil Conservation Trophy was won by Samia, Kajulu being second.

In the Gulf and part of the Southern Division of South Nyanza "operation mudlark" aimed at putting in narrow-base terracing, was again carried out and intensified, double-volume, narrow-base terracing being used up to 8 per cent slope; and single-volume terracing above that percentage. In the higher areas of those two divisions more uncultivated strips were pegged out for the new cropping season. In the Highlands Division of South Nyanza, nearly all land is controlled by trash lines. Banks resulting from old trash lines can be seen in grass; new trash lines are now put in as an established custom when land comes into cultivation. The trash lines are beginning to cause a marked benching effect and the whole countryside is beginning to have a sort of laterally "combed out" appearance. An innovation in 1950 was the use of diversion ditches, roughly like V-terraces, draining into grassed drainage ways, above slopes controlled by trash lines in order to aid the control of surface water.

In Kericho (African areas), the use of uncultivated strips is almost as general in cultivated land as is the use of trash lines in the Highlands Division of South Nyanza. The main object of our work here was to minimize encroachment by cultivation into strips. In all methods, maintenance annually is of paramount importance. Trash lines require least and in the end, when they have produced benching require none at all. Terraces require most and it is a sad fact that much terracing done in past years has to-day become useless through lack of maintenance; maintenance must ultimately be the individual's responsibility. Terracing is done communally; trash lines and uncultivated strips are made by

individuals after preliminary survey by our staff, who also endeavour to ensure lateral co-operation. As a result of the gradual spread of soil control, contour ploughing and cultivation are becoming commoner.

DAMS AND WATER SUPPLIES

A programme for the construction of dams and waterholes has been prepared in consultation with the Soil Conservation Engineer for the next two or three years for all African Districts of the Province. In 1950 construction was started in the Northern Division of North Nyanza by an African District Council Dam Construction unit, with tractors and European staff on loan from the Agricultural Department, and in the Sotik Division of Kericho (African areas) by a private contractor. In Central Nyanza and South Nyanza a few dams and waterholes were constructed by hand, and, in one place, by hired P.W.D. machinery. In all about 30 dams and 10 waterholes were built.

The importance of a good water supply to any attempt to improve land use is obvious. The localities selected for early dam construction have water and consequent cattle erosion problems. For instance, it is hoped to begin making dams on a rough semi-circle in the hinterland of Karunga, a small lake port near the Tanganyika border, in South Nyanza. At present nearly all stock in a whole location water near Karunga, at the lake, and have consequently caused very severe erosion in the rising ground behind the port. The semi-circle of dams will considerably reduce cattle movement and erosion and will in time give better cattle a better chance of doing well simply because walking will be reduced and water will be more plentiful. Another and similar example is that of the "Passchendaele" scheme in Kericho. In this case 16 dams have already been constructed.

IRRIGATION

The two main uses of irrigation in the Province are for vegetable and rice growing. Once a good market can be assured there are possibilities for irrigated vegetable growing in a number of localities which are near railheads. In the absence of good upland strains, it must be recognised that rice must be transplanted and irrigated. A great advance was made in Central Nyanza in that direction in 1950 where a very small production was more than trebled, nearly all the rice being transplanted and irrigated and much of it grown in rotation with sweet potatoes. The Agricultural Betterment Fund is used to aid the construction of water furrows in deserving cases.

Agricultural Education

Bukura Farm Institute.—In 1950 the Bukura Farm Institute was used exclusively for the training in farming of African families who would return to their own land and for refresher courses, mainly designed for Agricultural Instructors. At ten such refresher courses 118 Instructors underwent a fortnight's instruction. In addition, 26 parties comprising 831 Africans were conducted round Bukura. Only 13 of the family holdings were grouped into two demonstration group farms, the remaining holdings being retained as examples of consolidated individual family holdings. The holdings were generally run at a profit and crops within the Bukura boundaries were noticeably better than those outside them.

MEAN GROSS PROFIT ON BUKURA HOLDINGS IN 1950

Group	No. of Holdings	Mean Acreage	Mean Gross Return
Group 1	7	7.97	<i>Sh.</i> 662.81
Group 2	6	9.37	705.02
Ungrouped ..	6	6.37	489.49

Siriba Combined Training Centre.—This centre opened at the beginning of 1950, is run by the Education Department for the training of African Civil Service staff for the Education, Veterinary and Agricultural Departments. An Assistant Agricultural Officer is seconded to the school to run the farm and assist with agricultural instruction. Agricultural trainees comprised 23 who finished the second year successfully while another 30 entered on their first year. The land available for training purposes was divided into four small farms and are being developed to give practical instruction in an alternate husbandry rotation, group farming and the rehabilitation of poor grassland.

District Education.—The Agricultural Department assumed responsibility for agricultural education in all schools in the Province in 1950 based on small farms at secondary schools, and at primary schools on a series of plots demonstrating rotations, etc., adequate to the needs of the locality.

Agricultural Shows.—Highly successful shows were held in Samia, Gem (Central Province) and Idakho. At one, 600 competitive exhibits were staged; large crowds were attracted to all. Departmental exhibits included milking sheds and cattle *bomas*. Those shows, organised by the Location Advisory Councils, were run in close co-operation with the Veterinary Department and at all the livestock side was particularly and purposely stressed. It is considered that the location show is the best kind of show for an African area, creating local interest and a competitive spirit among the people.

Farmers' Day, European Areas.—A well attended farmers' day was held at Mr. Livingstone-Bussell's farm in West Sotik at which the Senior Pasture Research Officer stressed the importance of grassland.

Communications

Railway trucks and lighters fell short of the demand for evacuation of the large maize crop and, even with expanding railhead storage, will require to be provided on an increased scale for the future. African areas are, except for one or two cotton-growing localities, generally adequately supplied with roads although an improvement in their standard is desirable. Development of sugar production in the Indian areas is hampered by bad communications.

Pests and Diseases

The pests and diseases of coffee, cotton, passion fruit, potatoes and tea were mentioned in the crop section of this report.

Halo Blight of Beans.—This was present in nearly all localities, but did not cause serious loss.

Locusts.—Nil.

Mosaic Disease of Cassava.—The incidence was general but not severe.

Pink Ear Rot of Maize.—This occurred everywhere and is apparently on the increase.

Rosette Disease of Groundnuts.—The incidence was general.

Scale Insect on Cassava.—There were localized infestations, mainly in North Nyanza and Central Nyanza.

Stalk borer in Sorghum.—Stalk borer occurred mainly on sorghum and was most apparent in the Luo Locations of Central Nyanza where it has increased through past slackness.

Reconditioning and Resettlement

Resettlement of population in the tsetse reclamation schemes in the Alego Location of Central Nyanza, on the Oyani, Gori and Kuja Rivers and in the Lambwe valley and its subsidiary Simunye valley aimed at using population to prevent bush regeneration and the return of the tsetse flies after clearing, and at controlling land settlement and use. To avoid the use of paid labour year after

year on slashing of bush regeneration, it is advisable to site tsetse disinfestation schemes on land which can be settled. It is also desirable to "set aside" such areas suitable for settlement in order to exercise full control over land use and to overcome any claims that may be made to ancient occupation rights. Rainfall is frequently sparse in these areas and holdings as big as 50 acres are necessary.

The "Passchendaele" Scheme.—About 2,500 acres were closed to all livestock in Kericho Locations 4 and 5 near the Masai border to enable denuded grazing lands to recover, windbreaks to be planted and to construct a series of dams around the perimeter of the area to draw off stock concentrations and thereby minimize erosion.

The Bunyore Scheme.—The Bunyore and Maragoli Locations in North Nyanza carry too many humans for subsistence agriculture. Their easily eroded red soil is over cultivated and they have no room to keep enough cattle. A scheme commenced in 1950 to ameliorate these conditions provided for a concentrated soil conservation drive, for the making and application of compost and for the rehabilitation of some of the worst and most hilly land by closure and afforestation.

Kericho-Masai Barriers.—Settlement in the vicinity of the Kipsigis-Masai border at Chebunye and from Abossi to the Mara River aim, by bush and tree clearing, to create barriers so that tsetse fly cannot enter Kericho from Masailand. The breeding grounds of the fly in Masai itself are being tackled by E.A.T.T.R.O. In these settlements firstly five-acre blocks are cleared and settled by families, then cleaned blocks of 20 acres or more are allocated to families under single settlement rules for the control of livestock, the ratio of cultivation to grassland and the control of the soil.

The Agricultural Betterment Fund

The following table gives an analysis of the revenue and source of Agricultural Betterment Funds in each district:—

AGRICULTURAL BETTERMENT FUND, 1950

Commodity	North Nyanza	Central Nyanza	South Nyanza	Kericho
	£	£	£	£
Maize	208,978	19,744	107,251	52,540
Eleusine	174	10	1,473	—
Sorghum	1,390	23	265	—
Beans	151	26	—	—
Simsim	52	—	58	—
Cassava	1,592	911	—	—
Rice	615	234	—	—
Grain	12	7	56	—
Cotton	3,407	4,662	1,441	—
TOTAL	216,371	25,617	110,484	52,540

Investigational Work

Ley Establishment.—A number of preliminary experiments on ley establishment and early management with various grass species were put down at several places. These trials, none of which were replicated, were as follows:—

(a) *At Bukura.*—The following species were sown or planted under maize in order to observe their ease and rapidity of establishment, palatability and persistence under grazing: *Paspalum notatum*, *P. dilatatum*, *Bromus marginatus*, *Stenotaphrum dimidiatum*, *Brachiaria decumbens*, *Panicum makarikariensis*, *Melinis minutiflora* (Molasses grass), *Chloris gayana* (Rhodes grass). Molasses has so far proved much the best grass and Rhodes is very inferior.

(b) *At Bukura*.—Rhodes and Molasses grasses were sown under maize or sorghum with and without a dressing of farmyard manure. A fair establishment of molasses grass was obtained but Rhodes gave conflicting results, being good under sorghum unmanured, but practically a failure under maize manured.

(c) *At Bukura, Siriba and Kisii*—Molasses grass was sown with and without a preceeding green manure crop of Niger Oil, and with and without an application of 10 tons per acre of farmyard manure, under nurse crops of (i) maize, (ii) maize and pigeon pea, (iii) *Eleusine coracana* which was grazed. Indications were obtained that farmyard manure assisted the establishment of molasses grass; a preceding green manure is probably not advantageous as it delays the sowing of the grass until too late in the rainy season; growth of the grass was slowed down under maize but undersowing molasses in maize on land in good heart should be quite satisfactory.

(d) *At Kisii*.—Observation plots of 14 grass species were planted to determine the palatability and persistence under grazing but had not reached the grazing stage at the end of the year.

Crop Varieties

Sugar.—A large number of varieties of sugar cane have been imported via Amani and are under preliminary observation at Kibos. Three variety trials were planted, one on Miwani estate and two on Indian farms. The former compares five varieties in a latin square.

Cotton.—Replicated variety trials with eight varieties (N. 17, BP. 52, S. 37, K. 28, UK. 48, 5/57, A. 2106, A. 449) were carried out at 12 centres in the 1949-50 season, there being early and late planted replications at each centre. Seed of all varieties except BP. 52 and N. 17 (of which local commercial seed was used) was supplied by the Empire Cotton Growing Corporation, whose officers advised on these trials. Early planting was clearly superior to later planting. The most promising of the introduced varieties were S. 47 and UK. 48. In the 1950-51 season latin square experiments, with early and late planted replications, were put down at 11 centres to compare S. 47, UK. 48, BP. 52 and N. 17.

Cassava.—Seven mosaic-resistant varieties (Binti Musi, Msitu, 37244 E, F. 279, Kiu, Alipiri, and Valenca) were received from Uganda and have been planted for multiplication in preparation for field trials.

Rice.—Observation plots of a number of varieties were grown with a view to selecting the better varieties for a replicated trial in 1951.

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Provincial Agricultural Officer.

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Seasonal Conditions

A dry spell, following maize planting, after good rains in early March, in the Trans Nzoia and Uasin Gishu, necessitated replanting over a considerable acreage, and generally reduced yields of this crop. That wheat crop was favoured by well distributed rainfall in all districts during July/August. Some damage to the crop occurred in the Trans Nzoia owing to late heavy rains in September/October. In all districts below average annual rainfalls were reported.

Experimental Stations

Ol Joro Orok.—The main development of this station is now completed, including the building of offices for European staff, a four-bay implement shed and experimental concrete silos. Water was piped to the labour lines. The perimeter fence was nearly completed during the year and a thousand-yard wind break was planted to trees. The sub-division of the arable area has been finished and provides a seven-course planned rotational farm. The fields are now being entered into their appropriate phase in the rotation. This station continued to furnish the headquarters and experimental area for the Senior Agricultural Officer (Pyrethrum), and during the year Mr. J. L. Schofield, the Pasture Research Officer, was established at this station on a similar footing. Capital expenditure totalled £3,018, recurrent £3,053 while revenue amounted to £1,983.

Kitale.—The north end of the farm continues to be developed and is being laid down as a separate planned farm, which will work in conjunction with the original development. By the end of the year one new house had been completed by the Public Works Department and another was in course of erection. The old pipe line was handed over to the Prisons Department and a new section laid to serve the new houses and the requirements of the Station. New offices for the Coffee Officer and the Assistant Soil Conservation Officer/Inspector were completed and various modifications carried out to the dairy, shippon and calf boxes. A change over to Guernsey cattle is being accelerated, the present constitution of the female stock including 34 Guernsey/Native giving an average lactation of 374 gallons in 306 days, 20 Shorthorn/Guernsey/Native and 14 Shorthorn/Native giving an average lactation of 359 gallons in 317 days.

The important grass ley work on this station continues to give promising observations and is considered highly in the district.

With capital expenditure at £103 and recurrent at £1,463, revenue yielded £1,823.

Naro Moru.—Before his death Mr. Freeguard had completed excellent labour lines on the station and had commenced the erection of the Pump House for the irrigation scheme, on the banks of the Naro Moru River. Mr. Ballard completed this project, and the erection of a cattle spray dip. During the year the projected irrigation scheme was nearly completed, most of the piping had been laid, the pump was installed and the overhead spray equipment had been received. Fencing of the perimeter and subdivision of the grazing area into three paddocks is completed. Land was laid out and prepared for experiments under the direction of the Pasture Research Officer, in November, but total failure of the November rains prevented any progress. Tests with the new irrigation equipment suggest that difficulties may be expected from high winds which are prevalent in the area.

Nakuru.—No further development of note occurred on the 10-acre plots at Marindas and Rongai during 1950. A wide range of experimental work was undertaken on both plots.

Eldoret.—No finance was available for the acquisition and development of this station in 1950. Considerable replanting of wind-breaks was carried out but results were poor on account of rainfall conditions. Towards the end of the year it was confirmed that funds would be available in 1951 and stock piling of materials for development commenced in order to take advantage of the rising prices.

Production

EUROPEAN AREAS

This section of the report is supported by 20 tables, providing data from figures which have been obtained over the last five years for those crops which are scheduled under the Increased Production of Crops Ordinance, namely, wheat, oats, barley, maize, linseed (1949), sunflower (1950). It is considered that these crops are distinct from purely plantation crops, such as sisal, coffee, pyrethrum, tea and wattle which, being perennial crops, do not normally enter into ordinary arable farming procedure except that pyrethrum is now becoming a rotational crop in arable practice. The tables given below, in broad outline, present a sufficiently accurate picture to see the progress that has been made with the main arable crops over the last five years and most information that can be required for these crops is available from the figures which are presented. In all cases figures for 1950 are based on Agricultural Officers' estimates: for other years figures of actuals are supplied.

TABLES 1-6.—ANNUAL PRODUCTION, AVERAGE YIELDS AND ACREAGES OF CROPS SCHEDULED UNDER THE INCREASED PRODUCTION OF CROPS ORDINANCE

Table 1—Wheat

Year				Acreage	Yield per acre	Bags
1946	..	..	..	179,701	4.3	776,291
1947	..	..	..	183,363	3.6	665,496
1948	..	..	..	187,875	5.2	978,381
1949	..	..	..	209,955	5.5	1,162,382
1950	..	..	..	261,357	5.5	1,435,101 (est.)

Table 2—Maize

1946	..	..	..	92,752	7.4	684,878
1947	..	..	..	90,537	7.1	643,574
1948	..	..	..	97,677	8.3	807,136
1949	..	..	..	111,808	8.1	903,305
1950	..	..	..	133,536	7.5	1,000,999 (est.)

Table 3—Barley

1946	..	..	..	7,067	5.3	37,431
1947	..	..	..	8,621	4.9	42,525
1948	..	..	..	11,075	6.5	71,776
1949	..	..	..	18,757	6	112,724
1950	..	..	..	20,851	6.2	130,179 (est.)

Table 4—Oats

1946	..	..	..	4,680	5.7	26,779
1947	..	..	..	7,258	4.3	31,289
1948	..	..	..	12,237	6.7	81,949
1949	..	..	..	14,815	7	104,585
1950	..	..	..	18,920	6.8	127,879 (est.)

Table 5—Linseed

1948	..	..	..	5,921	1.7	10,058
1949	..	..	..	7,350	1.8	13,262
1950	..	..	..	4,848	1.8	8,938

Table 6—Sunflower

1946	..	..	..	2,634	—	—
1947	..	..	..	4,702	—	—
1948	..	..	..	12,364	—	—
1949	..	..	..	14,776	—	—
1950	..	..	..	15,694	5.7	89,717

Table 7—Analysis of Acreage Extension for Wheat, by Districts, 1946–1950

District	1946	1947	1948	1949	1950	Increase	Per cent Increase
Laikipia	15,519	15,859	18,088	19,580	24,118	8,599	56
Naivasha	19,671	22,841	28,894	40,239	57,484	37,813	192
North Nyeri	667	568	652	989	1,245	578	89
Thomson's Falls ..	35,857	39,268	47,634	60,808	82,847	46,990	131
Nakuru	52,622	57,477	50,498	57,691	66,204	13,582	25
Uasin Gishu	79,668	77,270	78,662	79,225	98,851	19,183	24
Trans Nzoia	12,221	9,916	11,733	12,231	14,812	2,591	21
PROVINCE	180,368	183,931	188,527	209,955	262,714	82,346	45

Table 8—Analysis of Yields of Wheat, in 200 lb. Bags

District	1946	1947	1948	1949	1950	Increase	Per cent Increase
Laikipia	83,185	75,876	101,042	116,250	132,227	49,042	59
Naivasha	93,297	86,550	166,829	203,073	293,202	199,905	214
North Nyeri	2,561	2,795	3,827	5,987	6,915	4,354	169
Thomson's Falls ..	179,043	165,221	271,698	325,310	432,344	253,301	141
Nakuru	261,055	216,953	293,842	351,281	408,395	147,340	56
Uasin Gishu	289,319	235,569	349,151	408,260	476,955	187,636	65
Trans Nzoia	49,435	50,548	67,517	77,131	90,234	40,799	82
PROVINCE	778,852	668,291	982,208	1,161,982	1,407,928	629,076	80

Table 9—Analysis of Acreage Increase for Maize

District	1946	1947	1948	1949	1950	Increase	Per cent Increase
Laikipia	130	236	674	902	1,195	1,065	846
Naivasha	142	259	470	594	231	89	63
North Nyeri	353	559	740	932	864	511	143
Thomson's Falls ..	625	1,054	1,884	2,428	2,290	1,665	272
Nakuru	21,171	25,068	31,086	33,071	35,651	14,480	68
Uasin Gishu	20,949	20,494	21,276	24,652	29,950	9,001	43
Trans Nzoia	50,360	44,480	44,171	51,657	65,645	15,285	30
PROVINCE	93,105	90,042	98,417	111,808	133,536	40,431	43

Table 10—Analysis of Yield Increase for Maize, in 200 lb. Bags

District	1946	1947	1948	1949	1950	Increase	Per cent Increase
Laikipia	1,310	2,185	5,426	5,984	8,916	7,606	585
Naivasha	1,022	1,068	3,231	3,303	1,221	199	19
North Nyeri	1,583	3,596	4,647	5,379	5,312	3,729	231
Thomson's Falls ..	3,915	6,849	13,304	14,666	15,449	11,534	294
Nakuru	183,838	224,878	266,000	247,355	282,422	98,584	53
Uasin Gishu	120,093	96,480	139,964	178,848	192,412	72,319	60
Trans Nzoia	378,615	318,963	392,515	462,436	510,716	132,101	35
PROVINCE	686,461	647,170	811,783	903,305	1,000,999	314,538	46

Table 11—Analysis of Value of the Wheat Crop for the Rift Valley Province, 1946–1950 Inclusive

Year	Sh. 200 lb.	Average yield	Average value p/a.	Yield in bags	Value £
1946	28.13	4.3	120/95	776,291	1,091,853
1947	27.00	3.6	97/20	665,496	898,420
1948	30.50	5.2	158/60	978,381	1,492,031
1949	32.50	5.5	178/75	1,162,382	1,888,870
1950	36.80	5.5	202/40	1,435,101	2,640,585

Table 12—Analysis of Value of the Maize Crop for the Rift Valley Province, 1946–1950 Inclusive

Year	Sh. 200 lb.	Average yield	Average value p/a.	Yield in bags	Value £
1946	13.50	7.4	99/90	684,878	462,293
1947	20.00	7.1	142/00	643,574	643,574
1948	20.00	8.3	166/00	807,136	807,136
1949	23.80	8.1	192/78	903,305	1,074,933
1950	28.80	7.5	216/00	1,000,999	1,441,439

Table 13—Total Value and Acreage of Scheduled Crops, R.V.P., 1950, and Percentage Relation to Whole for Each Crop

	Acreage	Per cent of whole	Value £	Per cent of whole
Wheat	261,357	62	2,640,500	58.7
Maize	133,536	28.5	1,441,500	32
Barley	20,851	4.5	148,400	3.3
Oats	18,920	4	113,800	2.5
Linseed	4,848	1	31,600	0.7
Sunflower	15,694	3.5	120,200	2.7
TOTAL	455,206	100	4,496,000	100

Table 14—Analysis by Districts of the Increase of Arable Acreage to all Scheduled Crops, 1946–1950

District	1946	1947	1948	1949	1950	Increase	Per cent Increase
Laikipia	16,272	17,245	21,233	23,925	29,074	12,802	78
Naivasha	22,797	28,191	39,147	53,250	71,801	49,004	215
North Nyeri	2,005	2,253	3,277	4,419	5,404	3,399	170
Thomson's Falls	41,074	47,689	63,657	81,594	106,279	65,205	159
Nakuru	79,611	89,372	93,730	105,354	120,206	40,595	51
Uasin Gishu	102,118	99,895	103,751	110,744	139,278	37,160	36
Trans Nzoia	63,344	55,076	56,924	64,993	91,301	27,957	44
PROVINCE	286,147	292,032	318,062	362,685	457,064	170,917	59

Table 15—Distribution of Arable Acreage Between Maize, Wheat and Other Crops for the R.V.P., 1946–1950

		1946	1947	1948	1949	1950
Total Arable	.. .. .	286,147	292,032	318,062	362,685	457,064
Wheat	Acres	180,368	183,931	188,527	209,955	262,714
	Per cent of total	63	63	59	57	58
Maize	Acres	93,105	90,042	98,417	111,808	133,536
	Per cent of total	32	31	31	31	29
Other Crops	Acres	12,674	18,059	31,118	40,922	60,814
	Per cent of total	5	6	10	12	13

TABLES 16 TO 19.—TABLES OF COMPARISON BETWEEN 1946 AND 1950, GIVING FIGURES FOR INDIVIDUAL CROPS AND SHOWING THE INCREASED VALUE TO THE FARMING COMMUNITY OF THOSE CROPS, AS A FIGURE AND AS A PERCENTAGE

Table 16—1946

Crop	Unit	Price Sh.	Average yield	Value p/a.	Acreage	Total yield	Total value £
	<i>lb.</i>						
Wheat ..	200	28.13	4.3	120.95	180,368	778,852	1,092,000
Maize ..	200	13.50	7.4	100.00	93,105	686,461	462,300
Barley*	180	12.00	5.3	63.60	7,067	37,431	22,460
Oats*	150	15.00	5.7	85.50	4,680	26,779	20,084
Linseed	200	65.00	—	120.00	—	—	—
Sunflower ..	100	12.00	—	70.00 (est.)	—	—	—

*Prices quoted are feed prices and not malting or milling.

Table 17—1950

Crop	Unit	Price Sh.	Average yield	Value p/a.	Acreage	Total yield	Total value £
	<i>lb.</i>						
Wheat ..	200	36.80	5.5	202.40	262,714	1,407,928	2,640,500
Maize ..	200	28.80	7.5	216.00	133,536	1,000,999	1,441,439
Barley*	180	22.80	6.2	141.36	20,851	130,179	148,404
Oats*	150	17.80	6.8	121.00	18,920	127,879	113,812
Linseed	200	70.80	1.8	127.44	4,848	8,938	31,640
Sunflower ..	100	26.80	5.7	152.76	15,694	89,717	120,220

Table 18—Increases in Values, 1946–1950

Crop	Unit	Price Sh.	Average yield	Value p/a.	Acreage	Total yield	Total value £
Wheat ..	Nil	8.67	1.2	81.45	82,346	629,076	1,548,500
Maize ..	Nil	15.30	0.1	116.00	40,431	314,538	979,139
Barley*	Nil	10.80	0.9	77.76	13,784	92,748	125,944
Oats*	Nil	2.80	1.1	35.50	14,240	101,100	93,728
Linseed	Nil	5.80	—	7.44	—	—	—
Sunflower ..	Nil	14.80	—	82.76	—	—	—

*Prices quoted are feed prices and not malting or milling.

Table 19—Percentage Increase in Value 1946–1950

Crop	Price Sh.	Value p/a.	Acreage	Total yield	Total value
Wheat	31	67	46	81	142
Maize	113	116	43	46	212
Barley	90	121	197	248	561
Oats	19	42	297	374	466
Linseed	9	6	—	—	—
Sunflower	123	118	—	—	—

Table 20—Gross Value Per Acre of Scheduled Crops Based on Ruling K.F.A. Prices and Average Yield Per Acre, 1946-1950

Crop	Bag- Unit	1946			1947			1948			1949			1950			Increase or Decrease in value per bag
		(1) Price	(2) Av. yield	(3) Value per acre	1	2	3	1	2	3	1	2	3	1	2	3	
Wheat ..	lb.	28/13	4.3	120/95	27/00	3.6	97/20	30/50	5.2	158/60	32/50	5.5	178/75	36/80	5.5	202/40	+ 8/67
Maize ..	200	13/50	7.4	100/00	20/00	7.1	142/00	20/00	8.3	166/00	23/80	8.1	192/78	28/80	7.5	216/00	+15/30
Mating Barley..	180	25/00	5.3	132/50	25/00	4.9	122/50	24/50	6.5	159/25	23/50	6	141/00	44/20	6.2	274/04	+19/20
Feeding Barley..	180	12/00	5.3	63/60	12/00	4.9	58/80	16/75	6.5	108/80	16/60	6	99/60	22/80	6.2	141/36	+10/80
Milling Oats ..	150	21/00	5.7	119/70	21/00	4.3	90/30	20/75	6.7	139/00	19/75	7	138/25	19/55	6.8	132/94	-1/45
Feeding Oats ..	150	15/00	5.7	85/50	15/00	4.3	64/50	18/75	6.7	125/60	18/50	7	129/50	17/80	6.8	121/00	+2/80
Linseed ..	200	—	—	—	65/00	—	—	67/25	1.7	114/32	67/00	1.8	120/60	70/80	1.8	127/44	+5/80
Sunflower ..	100	12/00	—	—	13/00	—	—	23/75	—	—	20/35	—	—	26/80	5.7	152/76	+14/80

This table indicates the measure of cash incentive per acre and shows the gross value per acre of an average crop as compared with any other, in any year.

For the purpose of compiling the above tables it will be noted that the figures for values have been arrived at using the current year's prices for the current year's production, while in fact the crop of any one year is usually disposed of in the subsequent year and, in practically all cases, would obtain a higher figure than that shown.

Wheat.—Wheat occupies over 262,000 acres of the arable land of the European districts. This is 58 per cent of the total arable (T.15) and the 1950 crop is valued at approximately 59 per cent of the total value of the scheduled crops in the province, at £2,640,000 (T. 13). Over the five years 1946-1950, there has been a 45 per cent increase in the arable acreage to wheat (T.7) and an increase in yield, over the same period, of 80 per cent, representing over 600,000 bags (T.8). Over the same period there has been an increase of Sh. 8/67 per 200 lb. net for wheat (T.20). The greatest extension of wheat growing is occurring in the Ol Kalou/Naivasha areas where over five years there has been an increase in acreage over 19,671 originally to 37,813, or 192 per cent (T.7). The Uasin Gishu still remains substantially the biggest wheat producing area, producing 476,955 bags on 98,851 acres (T.7 and 8).

There is little evidence of reduced yields to wheat (T.11) but this fact should not be misinterpreted. The average yield figures only convey an over-all average figure and when it is considered that an additional 82,000 acres have been put down to wheat in the last five years, it must be assumed that these are giving higher yields and off-setting the reduction in fertility on the original figure for 1946 of 180,000. It is most likely that the provincial average is maintained on this account and that wheat yields are generally below the averages indicated over more than 50 per cent of the area. This is an important consideration and should be taken into account with regard to other crops.

Throughout all districts the varieties 294 M and Equator have been predominant.

Maize.—In 1950 maize occupied 133,500 acres of the arable area of the province. This represents 29 per cent (T.15). The Trans Nzoia is the biggest producer of maize and in 1950 produced 511,000 bags off 65,500 acres (T.9 and 10). Over the five years 1946-1950 there has been an increase in acreage to maize of 43 per cent and an increase in total yield for the province of 46 per cent (T.9 and 10). The value of the crop is reaching £1½ million and represents 32 per cent of the value of the scheduled crops. The increase in the value of the crop over five years is £979,000, with an increased yield over this period of 314,500 bags, representing a 46 per cent increase in total yield and 212 per cent increase in total value. The price per 200 lb. has increased by Sh. 15/30 over this period (T.18 and 19).

The only important increase in maize acreages in the province over the last five years are shown in the Nakuru and Trans Nzoia districts; Nakuru has increased by 14,500 acres and the Trans Nzoia by 15,000 acres. In spite of a dry spell in the Trans Nzoia, following planting rains in 1950, the district anticipates the biggest harvest from this district to date. This is accounted for by over 20 per cent increase in acreage and a slightly reduced yield. Replanting was necessary over certain areas of the Uasin Gishu.

Barley.—A slightly increased acreage of this crop was sown but in spite of the fact that the price of malting barley provides the highest cash incentive per acre for scheduled crops in the province (T.20) the increase recorded is only of the order of 2,000 acres. There is a considerable demand for barley for pig feeding. The price in 1950 did not appear to be sufficiently attractive to increase the acreage of this crop.

Oats.—There has been a significant increase in the acreage of this crop, which has increased by over 20 per cent from 14,800 to 18,900 acres in the period 1949-1950 (T.4). This acreage does not include the utilization of oats as a temporary ley, which, although being carried out on a modified scale, is becoming

fairly common practice in the Thomson's Falls/Ol Kalou region. The crop in 1950 was a good one with the result that there is a surplus of milling oats and much of the crop will be disposed of at the lower feeding price (T.20).

Linseed.—Only 1 per cent of the total arable acreage and 0.7 per cent of the total value of the scheduled crops is reflected by linseed (T.13). There has been a reduction from 7,350 to 4,448 acres in the 1949-1950 period. The crop is grown on a very small scale and does not at present seem likely to increase. It is unlikely that with the favourable wheat price now prevailing that this crop will be produced on any scale except locally for feeding livestock.

Sunflower. The position of the sunflower crop (T.6) is being maintained but no significant increases are reported in any of the districts. It must be regarded as a minor crop, occupying only 3.5 per cent of the arable land and 2.7 per cent of the total value of the scheduled crops (T.13).

SUMMARY AND COMMENT ON THE SCHEDULED CROPS

It will be noted (T.13) that wheat and maize occupy 90 per cent of the arable areas of the province, and from tables 7 and 9 that the Thomson's Falls district, which includes the sub-districts of Laikipia, Naivasha and Nyeri, has 82,800 acres to wheat out of 106,300 total arable acreage (T.14); that Nakuru has 66,200 acres in wheat and 35,600 acres in maize, out of a total arable acreage of 120,200 acres (T.14). Similarly, these two crops occupy 129,000 out of 139,000 arable acreage in the Uasin Gishu, and 80,500 out of 91,300 in the Trans Nzoia (T.7, 9 and 14): that all other crops occupy a very low percentage of the total acreage in all districts may be taken for granted and it may be assumed also that although it appears that districts are growing both wheat and maize, for ecological reasons these crops are separated, and it follows without any doubt that something over 85 per cent of the arable land of the European districts of this Province are cropped continually to one or other of the main cereals.

CROPS NOT SCHEDULED UNDER THE ORDINANCE

Grass Leys.—Some headway can be recorded with regard to grass leys. For example, some ten tons of Molasses Grass seed were distributed to farmers in the Trans Nzoia in 1950. But these developments should be considered in the right perspective. The following points should be noted:—

(i) Well over 85 per cent of the arable areas continue to be mono-cropped to wheat or maize. The balance carries all other scheduled crops and an allowance for weed fallows has to be made.

(ii) The seed now being accepted on an increased scale is largely used for seed production as distinct from ley production. A large proportion of the seed crops are not used for stock but to satisfy the demand for seed. It is an indication that there is an awareness that leys must come, and seed prices are stimulated on this account.

(iii) At the present time, for all practical purposes, we are restricted to the use of two varieties for proved seeded leys, Rhodes and Molasses.

(iv) The introduction of the grass ley technique is a complex matter. The acreage figures show that the price incentive makes investment in cereal monoculture attractive. Further, capital invested for such enterprise is specialized, in many cases re-investment and extension has occurred, involving heavy commitments. The extent of specialized commitment in this way was used at one Production Committee meeting as a justification for demanding higher cereal prices in order to secure the investment. A switch from monoculture of cereals to mixed farming practice, based on short term leys, demands a wider field of knowledge and experience, permanent residence, and attention to the property, and further commitments in the way of paddocking, watering and building. While the incentive to cereal cropping remains profitable, the technical knowledge on the establishment and management of grass leys limited, and while the way of life is less exacting, it is difficult to anticipate any widespread extension of ley practice in the near future.

(v) In restricted areas at Kitale and Rongai the grass ley technique has been in use for several years, and there is evidence to support the contention that not only does the grass ley maintain productivity, but if adopted on reasonable fertility will maintain the total productivity from the original arable area.

To quote verbatim from the report of the Agricultural Officer, Nakuru:—

“Average yields of maize in the Rongai area under ley farming practices are in the region of 18 bags as opposed to five bags under continual cropping, likewise in the Njoro area relative yields of 14 and five bags, with and without leys respectively, have been noted in the wheat crop.”

(vi) The comprehensive, thorough and detailed farm planning now practised in the districts and most highly developed in the Nakuru district, introduces the temporary ley as orthodox procedure in the Plan. It is hoped that this work will originate, by example, general extension of better land usage, including the use of productive and managed grass leys, in spite of the difficulties outlined above.

(vii) To summarize: certain trends in the grass ley position are satisfactory, others are not so. It is probable that something under 4 per cent of the arable lands in the European districts are under grass, and a high percentage of this is devoted to seed crops, and therefore does not constitute practical ley farming. It is regrettable to have to record that the percentage of farmers practising managed, economic ley farming is very low.

Potatoes.—Small acreages, mainly for seed production, continue to be grown in the higher areas of the European districts.

Pyrethrum.—This crop has increased in acreage by 3.4 per cent since 1949, and the price has increased from Sh. 1/62 in 1949 to over Sh. 2 in 1950. The approximate acreages and yields per acre in the various districts of the province are as follows:—

	Acreage 1950	Average yield per acre in lb.
Thomson's Falls, including Naivasha and Kinangop	6,034	264.90
Nakuru	5,780	211.41
Eldoret (Uasin Gishu)	1,366	200.58
Kitale (Trans Nzoia)	270	263.96

Wattle.—Wattle is mainly grown in the Uasin Gishu, where the acreage continues to expand. It is grown to a lesser extent in all other districts. Acreage figures for the Uasin Gishu are as follows:—

1947	18,632
1948	20,037
1949	33,712
1950	45,653

The tonnage of bark delivered to the East African Tanning and Extract Company, Eldoret, from this Province was 5,424 tons and the value to growers £64,132.

Sisal.—Sisal is not widely grown in the Province but occurs importantly in the Kampi-ya-Moto area of the Nakuru district and, to a lesser extent, in the Trans Nzoia. Sisal Board statistics indicate the following production:—

1949	6,727 tons
1950	7,318 tons

The probable value to growers, depending on the nature of contracts was £746,000.

Coffee.—The following Coffee Board figures relate to the Province:—

Year	Acreage	Yield in tons	Value per ton	Total value to growers
1949	7,750	720	£ 161	£ 115,900
1950	7,750	755	351	272,025

Phormium tenax.—The Uasin Gishu reports: “A small group of farmers are still expanding their acreage of this crop, and there are three decorticating plants in the Kaptagat area to deal with 1,298 acres. Yields at the moment are about 1 ton per acre per year and a price of £160 per ton, £80 per ton No. 1 tow, and £50 per ton of No. 2 tow makes it an attractive proposition.”

This crop is now being grown on a nursery scale in the Trans Nzoia, where further development can be expected.

Livestock.—The following extract from the Annual Report of the Agricultural Officer, Nakuru, reflects the general position in the Province:—

“The general trend in the district is towards higher grade animals and in most areas the quality of the animals is much in front of the quality of the grass available. However, if more provision was made for dry season feeding a great improvement in the condition of the cattle and a rise in the milk yields would result. Farmers are becoming more and more aware of this particular aspect of animal management and a good increase in the acreage of fodder for ensilage and hay should be expected. It appears that the peak of pedigree breeding has been reached and many farmers who, two or three years ago, started building up a pedigree herd have dismissed the idea and are forming a good high grade type of herd, much more suited to their conditions and knowledge. If pedigree breeding is left to the few farmers in this country who have a deep knowledge of cattle breeding, there will always be sufficient good stock to maintain the commercial herds at a reasonable level.

Interest in the feeding of pigs has been maintained and with the improved marketing facilities it is expected that pig production will increase slightly in the coming year. The regulations attached to the keeping of pigs in pig-proof fences has probably prevented what would otherwise have been a very large increase in production.

Sheep are becoming more popular, both in the high and low zones throughout the district and this, no doubt, is a result of the large increase in price for wool. In 1949 surprise was expressed at a price of 61 pence per pound for local good quality wool. The 1950 price has been at least doubled and for selected wool 140 pence has been obtained.”

Pigs.—The following figures are extracted from the Annual Report of the Pig Industry Board for the year ended 30th June, 1950, and analysed as nearly as can be to provide figures applicable to this Province:—

			Estimated Value
			£
Baconers	.. .. .	24,569	193,503
Porkers	.. .. .	10,207	39,653
Larders	.. .. .	2,624	17,514
Total	.. .. .	37,400	£250,670

ESTIMATED VALUE TO THE FARMING COMMUNITY OF MAIN AGRICULTURAL AND STOCK PRODUCTS, EXCLUDING MEAT AND DAIRY, IN THE PROVINCE, 1950

	£
Wheat	2,640,500
Maize	1,441,439
Barley	148,404
Oats	113,812
Linseed	31,640
Sunflower	120,220
Wattle	64,132
Sisal	746,000
Coffee	272,025
Pyrethrum	316,000
Pigs	250,670
Total	<u>£6,144,842</u>

AFRICAN AREAS

General.—The main policy continues to be the discouragement of cash crops, and the encouragement of sound arable practices designed to furnish permanent productivity and local food requirements. The main cash income from the African districts should be acquired through stock disposal and not from crop exports. For certain reasons this policy has suffered serious set backs in 1950.

Price incentives and the example of the European districts have stimulated cash cropping for export in Nandi (maize, 44,000 bags) and in Elgeyo (wheat, cultivated by contract tractor). Both these extending enterprises failed to be redeemed by the inception of any sound practices and represent direct fertility exploitation. The position results from cash hunger and not from ignorance. The implications have been explained most thoroughly to the communities concerned, who merely point to examples across their boundaries, as justification for their activities.

The failure of the Kenya Meat Marketing Commission to offer sufficiently attractive prices for stock in the African areas almost brought to a standstill the development of stock sales in Samburu (sales reduced by 50 per cent c.f. 1949) and in Baringo (reduction 80 per cent), the two areas where cattle sales are vital and it had been anticipated that improvement would occur. Fortunately, those areas independent of the Meat Marketing Commission with markets available in Nyanza have not suffered and the policy has progressed, an economy with stock as a basis is established and sales have everywhere increased.

Apart from Nandi, where a disturbing percentage of the total cultivated area is under maize monoculture, African cultivation in the province consists of mixed cropping. Two markedly distinct types of cropping occur, depending on the climatic zone. The associated crops are:—

(i) *High Country.*—Cold and wet and growing maize, wheat, European potatoes, sweet potatoes, beans (*Phaseolus*), cassava, bananas.

(ii) *Low Country.*—Hot and dry, growing mtamas, wimbi, some bulrush millet, cow pea, dolichos, some sweet potato, some pigeon pea, cassava.

Crops

Maize.—Yields were generally on the low side, on account of the dry spell recorded under European areas. The crop, being the lazy manual farmers' crop and also palatable, continues to be widely grown, often in areas far too low for a reasonable crop to be expected. There has been no great increase in acreage to this crop, except as recorded for Nandi, where expansion continues.

Mtama (sorghum).—This crop is important in the lower areas to which it is agronomically suited. It matures rapidly, is easy to plant and harvest, and early

in its establishment it can weather dry spells. It yields well. It is most susceptible to weevil damage and specially selected weevil-free sites are chosen on the hillsides to store the crop communally. They have the appearance of small villages.

In the previous report, reference was made to the Kano variety being bulked for issue in the Kerio Valley. There were no takers for this crop, which was stated to be bitter in flavour compared with the locally grown mtamas. In appearance it was similar to the locally grown varieties, earlier maturing, shorter in the stem and appeared to yield better. I personally could detect no difference in flavour, chewing raw grain. This is mentioned as it is important to recognize that the introduction of agronomically suitable varieties of plants into new areas requires firstly that there should be a local demand.

Most of the sorghums grown in the Province are red varieties, but no names or trueness to type is ascribed to them.

Wheat.—This is grown mainly on the western boundary of Elgeyo, along the border with the Uasin Gishu, as was mentioned in the preamble. It is difficult to see any remedy for the unsatisfactory situation which is developing there.

Potatoes.—55,000 bags of potatoes passed through departmental inspection in the Elburgon area, mainly grown by forest squatters in that area. This must represent the largest single source of potatoes in the Colony and is an important industry. Potatoes are also grown in the Elgeyo highlands where they are used for local consumption and export to Eldoret.

Sweet Potatoes.—These are grown spasmodically in all districts. They are used for local consumption and the haulm is fed to small stock on a considerable scale.

Wimbi. (Eleusine).—This crop is widely grown on small patches in Suk, Elgeyo and Kamasia, and is probably on the increase. It enjoys an indifferent reputation as the grain is used in brewing and on this account steps to discourage its increase have been taken (*see* 1949 report). There are, however, certain good reasons why this crop should not be discouraged:—

- (i) It provides a good soil cover which remains when the heads are harvested.
- (ii) It is agronomically suited to the short season hot low country.
- (iii) The grain stores well and is palatable.
- (iv) There are plenty of alternative sources of brewing grains.

Cassava.—In most districts locational *shambas* were commenced in 1950 and planted up to this crop. This policy was adopted on account of the locust threat and the need to provide on a communal scale for such an eventuality.

As a result the crop is widely distributed through all districts. It is still only grown under duress, and in spite of constant propaganda a bare minimum is to be seen in the people's *shambas*. This is probably accounted for by the difficulties in lifting and processing for the table, as compared with other crops.

Livestock

The unfortunate position regarding livestock sales was discussed in the preable. The contrast between the first three figures which record operations independent of Kenya Meat Commission and the last two do not require comment.

	1949	1950	
West Suk	1,277	2,728	} Increases
Nandi	10,473	16,744	
Elgeyo	2,019	5,000	
Baringo	10,078	2,169	} Decreases
Samburu	7,100	3,450	

Produce Inspection

The main Produce Inspection Centre is at Elburgon, where 81,500 bags of forest squatter produce was inspected during the year. This was composed as under:—

Maize	21,650 bags
Potatoes	55,350 bags
Other crops	4,500 bags

In Nandi all maize for export to Control was submitted for inspection. Forty-four thousand bags of maize were inspected and exported from the district, with the result that 52 per cent of maize deliveries were graded K7 standard, and obtained a grading bonus of Sh. 1/05 per bag. This contrasts with the previous quality of Nandi maize, before inspection, which barely reached K8 standard.

Marketing

Marketing of all produce in the Province is effected through the variety of appropriate channels which exist for this purpose, Farmers' Associations, Control and Boards. It is not the purpose of this Report to comment in any detail on these Boards, except in so far as the farming community in this Province is concerned. During the latter part of the year a good deal of and widespread dissatisfaction was noted, particularly with regard to meat.

Famine Prevention and Relief

For the second year running there was no importation of foodstuffs officially into West Suk. The production in the Baringo highlands was again insufficient to meet the total demands of the district. Comparative imports into the district were:—

1948	7,350 bags
1949	1,850 bags
1950	2,697 bags

Progress in Improved Farming

EUROPEAN DISTRICTS

Reference is made elsewhere in this Report to:—

- (i) The extent of capital commitment in specialized equipment for cereal cropping on a large scale.
- (ii) The extent of the specialized technical knowledge required for a satisfactory switch to mixed, ley, farming practice.
- (iii) The less exacting way of life, accompanied by reasonable economic inducement implicit in cereal farming, especially on new land, with present incentives.
- (iv) The great expansion of acreage to cereal cultivation, which must be expected to continue.
- (v) The limited knowledge of ley grasses, their establishment and management.

To this list of deterrents to better farming must be added:—

- (vi) The generally low yields and indifferent returns available to the dairyman, which do not offer compensation for a more skilled and exacting way of life, sufficiently.
- (vii) The difficulties of switching over from worn arable lands, which begin to represent a large proportion of the arable areas, and the financial inducement not to do so in the case of arable lands still yielding moderately well and in condition to accept ley farming and economic utilization of leys.
- (viii) The high and rising costs of permanent improvements.

In spite of this list of serious deterrents to improved farming, definite and satisfactory advances are being made. There are two main reasons why progress can be recorded for 1950:—

- (i) The introduction of comprehensive farm planning for selected farmers in chosen localities, and the acceptance and enthusiasm for this service by the public in increasing measure.
- (ii) The amalgamation of the Soil Conservation Service with the technical agricultural advisory service, who now work jointly giving preference to planned farms. This amalgamation has stressed the need for the combination of a sound farming system with physical soil conservation works. This lesson, long overdue, is gaining ground everywhere. The dangerous idea that any sort of land usage could be superimposed on physical soil conservation works, is becoming a thing of the past.

Limited technical knowledge among the farming community of the European districts is more than offset by an above average standard of appreciation and education for an agricultural community. It is clear that propaganda for sound farming is not falling on deaf ears, and in spite of the difficulties in the path of progress propaganda by the Agricultural Officers has led to a general awareness of the pitfalls that lie in the continuation of unsound if profitable practices.

What amounts to a new academic subject is developing round Farm Planning and the co-ordination of services described under (ii) above. This work was developed under the guidance of my predecessor, R. E. T. Hobbs, and, although of recent origin, has developed extremely rapidly during 1950. In order to make best use of the limited staff and services available, some method of obtaining uniformity between the districts is becoming essential. In February, 1950, a meeting on a Provincial basis was held for Agricultural Officers concerned. Certain principles were laid down and considerable conformity in procedure was reached. The subject is rapidly becoming one that requires a course rather than a conference.

AFRICAN PASTORAL AREAS

Good progress with the management of the grazing lands in the African areas can be recorded for 1950. In West Suk, Nandi and on the Leroghi Plateau of Samburu a system of open and closed grazing areas, providing rest periods for the grazings, had been generally adopted by the beginning of the year. This represented a great advance on the indiscriminate grazing that had been the rule. By the end of the year a similar trend was taking shape in the Cherangani grazings of North Elgeyo.

The next phase which occurred very rapidly during 1950 was the control of unrestricted grazing, within the open grazings themselves. By the end of the year, especially in Nandi and on the Leroghi, the numbers of small herds which had been making use of the grazings independently were gathered into a few large herds, and restricted to specific portions of the open grazings.

This procedure must:—

- (i) Lessen damage by trampling.
- (ii) Restrict selective grazing.
- (iii) Give grazings a superior chance to build up.
- (iv) Increase carrying capacity.
- (v) Provide a larger balance of area for dry weather use.

It is therefore submitted that real progress has been made, even if it is unmeasurable. For this the greatest credit attaches to the Officers of the Administration in the districts concerned. They have carried the propaganda of this Department to the people with zeal and enthusiasm. The rigorous observation of control area boundaries by the Nandi, and the institution of powerful and well advised Grazing Committees amongst primitive people like the Samburu testify to this.

These remarks, except in the case of West Suk, refer exclusively to the higher and better grazings. No serious progress can yet be recorded for the semi-arid grazing areas such as occur in the low country of Baringo and Samburu and present problems which are technically most difficult to overcome.

AFRICAN ARABLE AREAS

These occur importantly in South Nandi, Baringo Highlands, Elgeyo Highlands and West Suk Highlands. Progress is hampered severely by a number of factors which include unsound traditional practices, lack of capital, bad communications, large areas, illiteracy and lack of appreciative faculties and the ever present language difficulty. Kiswahili is frequently not understood.

Superimposed on this is a staffing situation so indifferent that at the end of the year one district was without a European Officer and only one district had more than one European Officer of the Department on its strength during the year. These officers work in circumstances of comparative isolation, and on account of the necessity for frequent travel and bad communications, often of considerable hardship. In spite of this review of the position it is possible to record that distinct progress has been achieved, and in the circumstances it will be appreciated that the officers concerned deserve great credit.

In all districts, what had been purely demonstration plots of crop varieties, were converted to holdings showing the technique of mixed farming, the use of leys, the incorporation of stock into the arable system, either by the use of folds made of wattle hurdles (Nandi), or the use of tethers (Elgeyo and Baringo). A six course, 3 phase grass, 3 phase arable rotation is employed, and generally leys seeded to Rhodes grass have established successfully. There are signs that these plots are stimulating considerable interest among the peasants.

Criticism of the fact that this work is not done directly on *shambas* does not take into account our recent incursion into this field and the vital need to have pilot plots where systems of sound practice applicable to the financial, physical and mental capacity of the peasants and their requirements can be worked out. In fact, in most districts the holdings of selected peasants are used for extension work; while this may not be altogether advisable until we are better acquainted with the economy and permanence of the work, the urgency is such that within limits it is right to adopt this course. In Nandi, holdings have been fenced and paddocked and the adoption of a grass arable and a grazing rotation in the paddocks is encouraged. In Elgeyo and Baringo the grouping of holdings is practised and traditional cultivation periods are enforced and the holdings closed and put back to grass. Wherever satisfactory traditional practices are encountered, such as traditional periods of bush fallow, they are preserved vigorously.

Soil Conservation

EUROPEAN AREAS

Mention has already been made elsewhere in this Report of the advantages resulting from the amalgamation of the Soil Conservation Service with the technical Agricultural Advisory and Experimental Service and also to the excellent work that is being done in the field of farm planning. All units have been occupied to capacity and will be for a long time.

The scope of activity for this service is immense, as it is not merely concerned with terracing individual *shambas* on individual farms, but the main objective of Total Soil Conservation is kept continually under review. Every farm is regarded as being subordinate to a main drainage scheme and the fields within the farm as subordinate to the farm. The immense amount of survey and planning work involved can be appreciated.

Progress is limited by staff and equipment availability, but there can be no doubt that the conception of Total Conservation is the right one, and that it is preferable to work methodically along these lines than to effect piecemeal work without reference to major requirements.

AFRICAN AREAS

If the conception of total area conservation is the right one, it is as equally applicable to the African districts as to the European. By the same token these districts require similar facilities in the way of survey and planning, staff and equipment. No such service is available to the African areas, neither does anything comparable exist to replace it.

Guidance in soil conservation work in these districts is in the hands of Government and Local Native Council African staff, subordinate to the Assistant Agricultural Officer. Their appreciation of these matters is confined to the need for various forms of wash stop on arable land. These include narrow based terraces, grass strips, stoned and staked rivets, trash lines and many other simple and primitive methods of arresting surface erosion. Such work is now general on most of the arable lands in all the districts and collectively is doing a great deal of good. Regular and careful maintenance of this work is essential but difficult to secure. Frequently breaks in terraces occur, which cause gulying and damage that would not have occurred if specifications had been maintained or if the land had never been terraced and the water allowed to accumulate and spill. Damage from this source can be over exaggerated and on balance the work that has been done has done good.

It is necessary to appreciate that this *shamba* protection service is not related to any main area drainage schemes and that there is no staff to complete the surveys which would be required to do this. It cannot therefore be considered in the same light as district soil conservation in the European districts.

Agricultural Education

EUROPEAN AREAS

The faculty of Agriculture at the Egerton School has continued successfully throughout the year and provides various qualifications for the students.

Young Farmers' Clubs have been running successfully in the Trans Nzoia and Nakuru districts and are strongly supported by the Agricultural Officers.

Farmers' Days have been run in all districts on farms and at Experimental Stations and have been splendidly attended.

AFRICAN AREAS

The Province is still without an Agricultural School where Africans can qualify to become sound Instructors in the districts. There is great difficulty in these primitive areas in finding candidates suitably qualified educationally to undertake such a course. All the schools provide limited agricultural education, and many have small holdings, which it is hoped can in time be modelled on the Departmental Holdings.

Agricultural education for the mass of the people continues to be confined to *Barazas*, where language difficulties and lack of appreciative faculties combine to require that directions based on Local Native Councils resolutions rather than instruction are given.

Pests and Diseases

Stalk Borer.—Slight infestation of stalk borer has been reported from all districts but attacks were generally localized. It is possible that burning will be required in 1951. Control of the pest by D.D.T. and Diatomite and Derrisol has been effective.

Wattle Weevil.—Damage by this pest was recorded in the Uasin Gishu and Trans Nzoia and some damage was done to young maize. Control by D.D.T. and Diatomite was partially successful.

Beetle.—Serious damage was done to cereal crops in the young stage in the Thomson's Falls/Ol Joro Orok area by attacks from two or three different varieties of beetle. In certain cases whole fields were wiped out and had to be replanted. This will be the subject of investigation by the Senior Entomologist in 1951.

Locusts.—No locusts were reported in the Province during 1950.
NOXIOUS WEEDS

Datura stramonium.—This weed continues to be troublesome in most of the wheat areas and accounts for a heavy labour cost annually for its eradication.

Darnel.—This weed occurred in the Trans Nzoia district for the first time, having been imported in two consignments of wheat seed.

Research and Investigation

Research and investigation in the Province has been undertaken on an increasing scale during 1950. This work is done on a district basis by the district Agricultural Officers and detailed reports of the work are attached to the district Annual Reports. It is felt that it is unnecessary to extract material which has already been dealt with in full detail in these Annual Reports and reference, with regard to specific experiments, should be made to these Reports.

The work has been carried out on departmental Experimental Stations and plots in the Uasin Gishu, Thomson's Falls and Nakuru districts. In addition considerable co-operation has been received from the farming community, who have assisted with extension experiments. The following general comments are suitable for the Provincial Report.

There has been considerably increased interest in introduction of exotic grass species. Kentucky 31 Fescue is giving promise both at Ol Joro Orok and the lower areas of Molo. The causes of the deterioration in rye grass in the F_1 and F_2 generation are under examination. This work is considered to be of great importance. Cocksfoot continues to give encouraging results over 8,300 feet but in all this work we have not yet reached a stage where the effects of management by stock on a field scale can be worked out. The question of management by stock has not been given sufficient consideration and it is welcome to note that satisfactory work of this kind was undertaken at Ol Joro Orok on oat leys and an area of *Bromus* grazing.

An experiment carried out at Kitale with the object of attempting to contrast different quality supplementary diets with ley grazing did not appear to give conclusive or satisfactory results. It would seem that with our present staffing and facilities we are not in a position to effect animal nutrition experiments satisfactorily and that it would be wise to rely on other organizations, with better facilities, for information of the kind required as, on the scale and with the technique available to us, results of any kind must be open to question and may well be misleading.

In another field, which is of great importance, work has been carried out on experiments with various types of vlel drainage with the object of recovering this type of land for arable production. Reference to the work done at Ol Joro Orok reveals a very low yield in comparison with the rest of this property and better results had been hoped for. There is some reason to believe that more attention should have been paid to the phosphate level and that the real value of this work was masked by the low phosphate level. Further work will be carried out in 1951.

AFRICAN AREAS

Experimental work in the African areas has been confined to searching for the simplest data in connexion with the management and economy of small holdings, having regard to the physical and financial capability of African

peasants. Without any doubt this work is of the highest value and while it can hardly be described as experimental, such simple matters as determining how to manage grazing on thin strips of grass land are receiving the attention they deserve. It is intended that this work should be the subject of a comprehensive report when further investigation justifies this step.

In view of the fact that our incursion into these African reserves is recent and that almost every aspect of land usage by the peasant concerned is open to speculation, there is a tendency to regard every sort of agricultural management and administration as either experimental or a Scheme.

The sub-division of grazing into paddocks at Kisikon in South Kamasia in order to obtain logical grazing management and the development of wet weather high density grazing and stall-feeding in the dry months at Solai may be regarded as coming under this heading as also may the development of grazing management within the open areas of Leroghi and in Nandi. These important practices are, in fact, only part and parcel of sensible government and direction.

General

Tribute must be paid to the organization in this Province developed by Mr. R. E. T. Hobbs, including work over 10 years at Kitale, and the excellent team at the Provincial office. This agronomic work, in conjunction with the work done by Mr. Colin Maher with regard to Soil Conservation is now amalgamated and has led to the very real development in land usage technique which is now available, and gives promise of showing the way to staffing, administering and improving the whole of the agriculture of the European highlands of Kenya, and the highest tribute is deserved by these two officers who so materially served this Province.

To know something about the direction and means of achieving progress does not constitute achievement in itself and a time lag must be anticipated between the inception of any idea and its application in practice by the farming community.

A large, influential and important section of the farming community of the European districts of this Province enjoys a higher standard of education and receptive capacity than is common in agricultural communities, and it must be anticipated that the great measure of co-operation we are now receiving from more enlightened and responsible farmers in this Province will increase rapidly and gather momentum. To these, as well as to the great number of well wishing farmers who, for staffing reasons, and, in cases, on account of physical conditions, we are not able to help, the Colony and this Department owe a great debt of gratitude.

GEORGE S. COWLEY,
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ANNUAL REPORT OF THE PROVINCIAL AGRICULTURAL OFFICER, CENTRAL PROVINCE, 1950

Climatic Conditions

The failure of the 1949 short rains left the Province in a poor way to face the dry months of January and February. Fortunately, however, planting rains occurred early in March and the long rains generally, except in Ukambani, were well above average, April and May being generally wet with rain also extending into June. In Machakos and Kitui the long rains were of such short duration that harvests were very poor and food relief had to be maintained throughout the year.

The mist season in the upper areas was exceptionally wet and cold and these conditions caused widespread blight damage to the potato crop. It interfered also, to some extent, with harvesting of maize. Generally speaking, however, long rain harvests, except in Ukambani, were far above average and large surpluses of foodstuffs were produced, much of which found its way to Machakos and Kitui.

The short rains were unfortunately both late in arriving and of short duration. December rainfall was well below average and the January finishing rains failed to materialize. The failure of the November rains was most serious in Meru and Kitui, which districts regard this season as the main harvest.

RAINFALL

Station	1950	Mean	Station	1950	Mean
MERU	69.79	56.98	FORT HALL ..	53.52	46.89
Chuka	56.79	57.06	Murirangas..	69.30	60.61
Tharaka ..	32.16	—	KIAMBU	34.79	37.61
EMBU	51.49	42.22	Githunguri ..	43.94	47.23
Kerugoya ..	58.50	50.23	MACHAKOS ..	25.93	35.80
Sagana	37.61	39.47	Mataliku	22.98	27.71
Ishara	21.02	27.93	KITUI	23.50	35.37
NYERI	29.99	30.86			
Othaya	55.78	47.34			
Karatina ..	60.46	49.90			

Production

CROPS

Bananas.—These were in short supply during the first months of the year as the plants had suffered severely from the 1949 drought. The heavy long rains experienced in the banana-growing districts rapidly stimulated the production of bunches and good yields were obtained throughout the second half of the year. Apart from providing a very large quantity of food for internal use, the value of exports—largely to Nairobi—is estimated at £20,473.

Beans.—The 1949 short rain crop was badly droughted and little or no harvest was obtained. The long rains crops were generally well above average, particularly in the lower and middle areas with the exception of Ukambani, but at the higher altitudes the intensely wet and misty conditions at flowering and harvest seriously reduced yields. In Mbere, which lies at or below the 4,000 ft. contour, the Agricultural Census revealed an average yield of 5.2 bags, which must be far above normal. There was a considerable increase in the production of white haricot beans, largely from Embu district, and 27,046 bags were exported. At the end of the year the short rains crop was very poor in appearance and was unlikely to yield well. Sales totalled 42,331 bags of beans valued at £68,157.

Cassava.—The stock of Cassava in the soil was seriously depleted in the two Akamba districts by the persistence of food shortage conditions. Considerable quantities of cuttings were obtained from Nyanza for planting in the November rains but most unfortunately rain was inadequate for their successful establish-

ment and much material was lost. In Meru and Embu the position is far more satisfactory and reasonable reserves of food in the form of cassava exist in the soil.

Coffee (Arabica).—The following table shows the present position in Meru, Embu and Nyeri districts:—

District	Total Acreage	Total Growers	Total Crop	Sales
			<i>lb.</i>	<i>£</i>
Meru	866	3,408	72,123	16,842
Embu	85	363	—	4,057
Nyeri	79	310	—	Nil
	1,030	4,081	72,123	20,899

These figures represent an increase of 497 acres and 1,845 growers over the 1949 figures. In Meru district only, approximately one-seventh of the acreage shown above is in bearing. The economic importance of coffee will make itself increasingly felt in the general economy of that district. In the past, coffee cultivation was restricted between the 5,800 ft. and 5,400 ft. contours but in recent years a number of plantations have been tried at elevations down to and even below the 5,000 ft. line. To date, these plantations have made excellent growth and coffee even at 4,500 ft. provided a suitable variety is found, might be envisaged. The general care and cultural methods practised by the Meru cultivator remained at a high level during the year and the average yield of bearing coffee was a little under 10 cwt. of clean coffee per acre. Quality also was excellent, 73 per cent of the crop being classed in grades two to four. The average price for Meru coffee was £398 per ton.

In Embu district, largely because of staffing difficulties, no great expansion took place and the general care of coffee in Ngandori location deteriorated temporarily, though elsewhere cultural methods were quite satisfactory. In Nyeri, the small acreage planted in 1949 was increased to a total of over 77 acres and it is hoped that this will prove to be the nucleus of a considerable coffee industry in that district.

A new factory at Chuka was built during the year but the machinery had yet to be installed. Work on the new Meru factory was commenced and plans for factories in Embu finalized. Building of the latter was not possible owing to shortage of staff.

Colocasia.—Although still widely grown in wet, swampy places, no increase, possibly the reverse, is noticeable.

Cowpeas.—Are more widely grown as a vegetable and of considerable importance in the low arid areas. Long rains yields were generally above average and exceptional long rains yield figures were obtained in Mbere. Sales were 1,731 bags valued at £1,878.

Dolichos.—Although grown over a wide area, this crop is only of great importance in the northern portion of Meru district. The 1950 crop was excellent and produced the biggest surplus known, 27,188 bags. Exports were valued at £67,970.

Grams.—Are extensively grown in Meru and Embu. Long rains crops, as with other legumes in the lower middle areas, were well above normal and yields appeared to average about three bags per acre. The food miners in the Mwea reaped a handsome cash reward for their efforts in destroying valuable grazing by ploughing it up. The quantities of the various types of gram sold are given under the Marketing heading. The total value was £43,982 from 18,385 bags.

Maize.—The 1949 short rains crop which should have been harvested early in 1950 was a complete failure but average yields were obtained from the "Gathano"

or mist season crop. The main long rains crop was one of the largest for some years in Embu and the three Kikuyu districts but at the highest altitudes, wet, misty weather at harvest somewhat reduced yields. The large surplus resulting from the long rains crop was largely absorbed in the neighbouring Kamba districts with a serious loss of Agricultural Betterment Fund moneys to the districts concerned. No doubt the sellers profited considerably. Grain stores in the Kikuyu districts were well filled by this harvest which was indeed fortunate as the short rains failed once again.

The short rains maize crop never really stood a chance for it was planted late and experienced insufficient rain in December. The January finishing rains were conspicuous by their complete absence. In spite of repeated failures, cultivators continue to plant maize in the short rains, which is well nigh criminal in Machakos, and then expect a benevolent Government to provide food for them. The position has been aggravated as in many cases the original seed has been lost and Nyanza types have been planted. Exports from the Province were 132,340 bags, valued at £77,580.

Millets: (1) *Bulrush*.—The 1949-50 crop was below average in Meru and elsewhere only very light crops were reaped. The 1950-51 crop also was poor but in spite of quite inadequate rain it yielded somewhat better than at one time seemed likely.

(2) *Foxtail*.—1949-50 crops were below average but the 1950 crop planted in the "Gathano" was a great deal better than usual and yielded well.

(3) *Finger*.—Only isolated patches are grown. Exports from the Province were 11,840 bags of millet valued at £8,775.

Onions.—Continue to provide the cash from manured shambas in Kiambu wherewith to repay back the loan money. Nyeri district reports a growing interest in this crop but Meru failed to find a satisfactory market for its irrigated crop. The sales of 4,836 frasilas were valued at £3,217.

Peas (field).—As a cash crop confined to Meru and Kiambu. The 1950 Meru harvest was excellent and this crop is becoming increasingly popular. Sales were 6,401 bags valued at £10,495.

Pigeon Peas.—The 1949-50 crop was generally severely droughted at the start and owing to the inadequacy of the 1949 short rains, the acreage was less than usual. Where the crop survived the dry season, except in Ukambani, yields were satisfactory but only a small surplus was marketed. Fusarium Wilt and drought seriously reduced yields of pigeon peas in Machakos. The young crop planted in November appeared healthy at the end of the year. Sales were 2,155 bags valued at £3,954.

Potatoes (English).—The 1949 short rains crop in Meru was excellent and produced a surplus of 34,000 bags. That from Kiambu was good without being exceptional. The very heavy long rains rather naturally induced a high incidence of "Blight" and generally speaking yields were very poor in spite of the issue of large quantities of blight-resistant seed. A large acreage was again planted in Meru in the 1950 November rains and both this crop and that in Kiambu were fair at the end of the year, in spite of lack of rain. Sales were 99,219 bags valued at £61,427.

Potatoes (Sweet).—The excellent long rains over the more densely populated portions of the Province allowed the acreage of this crop to be increased after a severe set-back in 1949. The vines continue to occupy an important role as stockfeed. In Machakos, persistent drought reduced the acreage and planting material is still short.

Pyrethrum.—A recent survey in Kiambu revealed that at present there are 300 acres under pyrethrum, principally in the Limuru-Uplands area. This is a very considerable factor in local economy. Sun drying is the rule although there are a number of simple charcoal burning driers. In spite of this, quality of the product

is reasonable. In Nyeri district, where at first there was considerable feeling against this crop, pyrethrum is now exceedingly popular and the demand for transplants or splits has taxed our resources. Permission to plant 80 acres in this district was obtained from the Pyrethrum Board. Sales were 56,773 lb. of dried flowers valued at £2,861.

Rice.—A small variety trial plot in the Mwea produced an average yield of 6,000 lb. paddy to the acre. There is little doubt that rice, provided it is grown correctly and in the right season, is most suited to this area. A few cultivators have shown some interest and extension in a moderate way is expected.

Sisal.—The very high price of East African sisal fibre induced a number of commercial concerns to interest themselves in the purchase of sisal in the African areas. In Machakos district, particularly, where a large amount of leaf was available, this new source of income was rapidly exploited by the cultivators who frantically, and without thought for the life of the plants, hand decorticated large quantities of fibre. The cash received, however, came at a most opportune time as this district was largely dependent on purchased food for the greater portion of the year.

In Nyeri district, the factory operated by a European was moved outside the Reserve at the request of the Assistant District Commissioner. The prices paid for leaf are, therefore, very low as transport costs are high. Sales in the Province totalled 11,076 tons of leaf and 4,961 tons of fibre, valued at £279,496.

Sorghum.—In spite of a severe dry season, the sorghum crop, except in the worst droughted areas, came through reasonably well and the ratooned crop produced satisfactory yields. It is unfortunate that the Akamba will not realize that their country is essentially millet and sorghum land and is generally not suited to maize. Famine would be far less prevalent if this were the case. There was no surplus for export.

Sugar Cane.—Is used largely for the manufacture of beer and is widely grown in the moister places.

Tea.—Four acres of tea were planted at stake in Mathira Division of Nyeri district. This practice was allowed so that the great enthusiasm for this crop shown by the local people should not evaporate. The plantations were remarkably well tended and largely because of the care bestowed on the young plants they came through the dry season successfully. The remainder of the seed was planted at the Kagochi tea nursery and a number of transplants should be ready for planting out in 1951.

Tobacco (Flue-cured).—

DISTRICT	SHORT RAINS (Green Leaf)			LONG RAINS (Green Leaf)		
	Acres	Lb.	Paid to Growers	Acres	Lb.	Paid to Growers
			<i>Sh.</i>			<i>Sh.</i>
Embu ..	Nil	Nil	Nil	66	329,325	14,690·00
Fort Hall ..	20	16,457	615·15	44	172,095	7,637·32
Kitui ..	100	500,849	21,420·00	125	710,443	35,200·00
TOTAL ..	120	517,306	22,035·15	235	1,211,863	57,527·32

The first crop in Kitui, that is the one harvested in January and February, was poor owing to drought. In Embu a complete absence of planting rain resulted in no crop being planted. In Fort Hall, 20 acres was achieved but the yield and quality were very low. The long rains Kitui crop was very satisfactory and produced leaf of fair quality from 125 acres. The Sagana crop, particularly that from Embu district, was excellent, and gave satisfactory cash returns to the growers.

No success was achieved with the "third season" crop referred to in the 1949 Annual Report. In spite of careful supervision at the time of planting and due care henceforward the irrigated crop did not thrive. It can only be assumed that the cool, overcast conditions of August and September at the time the plants should be making most growth, were detrimental. Prospects for the 1950 short rains crop were poor at the end of the year. Purchases by the East African Tobacco Company totalled 1,729,169 lb. green leaf valued at £3,928.

Tobacco (Native-cured).—Native tobacco is increasing in popularity as a crop in Nyeri and Meru districts and their product is sent all over the country. It is not possible to obtain statistics of the total quantities sold, largely to itinerant traders, but recorded sales show exports to have been 874,976 lb. valued at £32,900.

Vegetables, Fruit and Flowers.—The urgent need for a central organization for the marketing of perishable produce has still not been met although new plans were considered during the year. With one or two exceptions, therefore, fresh produce is marketed on hit or miss lines. "Tendergreen" beans, in small quantities, were produced in Nyeri for Messrs. Kenya Cannery, Ltd., during the long rains but the second crop largely failed through drought. An experimental crop of celery grew very well but was found to have a high percentage of "heart rot". In Kiambu the acreage of Smooth Cayenne pineapples is increasing yearly and in the near future, as the fresh market becomes saturated, considerable quantities of pines should find their way to the canners. Considerable quantities of vegetables and fruit are grown each year in Kiambu and the Iveti area of Machakos for sale in Nairobi, and from the former district a number of flowers as well. In Fort Hall most unfortunately the Tusso plum growers threw away the chance of a good market by failing to grade their crop properly. The value of exports, and with proper organization at the head, the figure would be far higher, was £57,938.

Wattle.—Prices remained high and this crop, the largest single revenue producer in the Province, held its great popularity. It demands little attention between planting and cutting some 8 to 10 years later, apart from casual thinning. During the January–March season, the purchase of undergrade bark was permitted for the first time and the price paid for this commodity, which previously had been unsaleable, appeared most attractive to growers. In the northern portion of the Kikuyu districts little trouble was experienced, but at Thika, particularly, producers failed to sort their bark properly and considerable chaos ensued. Eventually a considerable quantity of bark containing a high proportion F.A.Q. had to be bought as undergrade. This, unfortunately, was repeated in the August–October season when there were the added difficulties of very wet, misty conditions in the upper areas. The price of undergrade bark, based on the original analysis of samples, was such that growers tended to fell and strip immature trees and the proportion of undergrade bark sold at Thika was 30 per cent instead of 10 per cent, on which latter figure the quotas had been based.

In Embu the bulk of over-mature trees have been felled and not before this was necessary. No great surplus of bark now exists in this district. The high prices ruling made it possible to continue with the export of Meru bark and a large number of trees which certainly would not last much longer were felled and stripped. The quality of this bark has been reported on by the wattle companies as being the best in the country.

The Province marketed 35,627 tons of wattle bark valued at £364,270.

Wheat.—In Meru, increasing quantities are consumed locally. Nyeri reports a greater response to propaganda to increase the area under wheat at the expense of maize in the short rains. In Fort Hall, other than at schools, the response to similar pressure has been less. Sales were 599 bags, valued at £882.

Yams.—The popularity of this crop has never really attained that degree which it held prior to the serious Mealy Bug outbreak before the war. It is, however, a useful food reserve and still widely grown in Meru.

LIVESTOCK

Hides.—There was a marked drop in the quantity of hides recorded as being sold but there is little doubt the figure shown is on the low side. The value of hides sold shows little change from the previous year. Undoubtedly the efforts made by the Veterinary Department to improve quality have borne fruit and a far greater interest is being taken, particularly in the large stock-owning districts, in the preparation of hides. Sales of 16,983 frasilas were valued at £49,787.

Skins.—Both prices and the quantity sold increased. The remarks concerning the preparation of hides apply equally to skins. 25,903 score were recorded as being sold, valued at £112,757.

Pigs.—The number of pigs sold through the Nyeri Co-operative Society showed a further increase—651 head valued at £2,133.

Poultry.—Recorded sales at 174,576 head to a value of £22,896, were again far lower than in the previous year, probably because it is becoming more and more difficult to keep a check on all exports.

Eggs.—A further decline in egg sales, probably for the same reason as given in the case of poultry, occurred. The Meru Egg Depot had to be closed down during the year, largely because it was only supported in periods of glut when Meru eggs could not be sold. The controlled marketing and inspection of eggs in Central Province with all its outlets continues to present a major problem. Recorded sales were 4,302,115 eggs valued at £22,938.

Produce Inspection

The export of produce was prohibited in many districts for the greater part of the year and produce inspection staff was largely employed on preventive measures. How difficult these measures are to enforce is exemplified by the following extract from the Meru Annual Report: "In spite of threats to his person (the Produce Inspector) and the offer of large bribes, it was only when he was held up with a shot-gun that produce got through". Similarly, after the excellent long rains crop had been harvested and the export of foodstuffs was permitted, it was well nigh impossible to ensure that Maize and other products went to the Control. The Agricultural Betterment Fund contribution of Sh. 3/40 per bag in the maize price structure provides a bargaining margin of Sh. 112 per lorry load. Producers can, therefore, obtain a better price outside Control and afford the luxury of paying a handsome bribe as well. The famine conditions in the neighbouring Ukamba districts aggravated the position and many thousands of bags of produce left those districts with a surplus without contributing to the A.B.F.

The appointment of European Wattle Inspectors was of very great assistance at the Wattle Inspection Centres, in fact, it would have been quite impossible to have dealt with the problems without them.

Marketing

The establishment of Marketing Officers, although several transfers took place, remained at four. Although these officers have done most useful work and have saved the time of our trained agriculturists which would otherwise have been devoted to routine marketing matters, they still feel the acute lack of a central marketing organization. This aspect was mentioned in the 1949 Central Province Annual Report and should be stressed once more. The potentialities of the Province for the production of fresh produce, such as vegetables and fruit, are enormous and it is felt that the demand in the country could be stimulated and increased if produce was presented and marketed in an orderly manner. Central Province wishes most earnestly to see the new organization set up for the marketing of horticultural products. In addition, it is hoped that African producers in Central Province will be able to participate to a much greater degree in the production of articles for canning, such as pineapples, green beans,

asparagus, celery, etc. Some patience on all sides will be necessary as the African is generally slow to avail himself of new opportunities.

The total revenue derived from products of the land was £1,707,805, which, although considerably more than in previous years, still only represents less than Sh. 80 per taxpayer. The immediate aim should be £20 per taxpayer but this could only be achieved, if fertility is to be maintained, by much greater attention to the production of high-priced crops properly farmed.

QUANTITIES AND VALUES OF PRODUCE SOLD

Produce	Unit	SALES 1949		SALES 1950	
		Quantity	Value	Quantity	Value
			£		£
Maize	Bags	68,570	50,620	132,340	77,580
Millet	"	34,300	30,644	11,840	8,775
Sorghum	"	2,045	2,500	—	—
Wheat	"	644	742	599	882
Beans (Wh. Haricot) ..	"	9,885	10,756	27,046	40,957
Beans (R.C. and C.W.)	"	5,905	5,629	15,285	27,200
Peas	"	4,111	4,506	6,401	10,495
Cowpeas	"	1,861	3,410	1,731	1,878
Dolichos	"	12,604	31,516	27,188	67,970
Yellow Gram	"	307	721	334	898
Black Gram	"	4,872	11,717	9,425	22,760
Green Gram	"	5,963	11,916	8,526	20,234
Bengal Gram	"	1,098	4,343	—	—
Pigeon Peas	"	7,658	14,217	2,155	3,954
Potatoes	"	145,731	103,313	99,219	61,427
Pyrethrum	Lb.	5,414	270	56,773	2,861
Tobacco (Fl. Cd. Green)	"	1,830,387	4,266	1,729,169	3,928
Tobacco (Nat. cured) ..	"	342,819	16,194	874,976	32,900
Coffee (Parchment) ..	"	54,056	4,952	93,448	14,973
Coffee (Mbuni)	"	29,524	1,269	131,759	5,924
Vegetables, Fruit and Flowers	Tons	9,261	113,949	3,629	57,938
Bananas	"	4,375	29,700	1,615	20,473
Onions	Frasila	4,973	3,493	4,836	3,217
Beeswax	"	1,652	6,752	434	2,543
Wattle Bark	Tons	39,826	415,710	35,627	364,270
Fuel and Poles	"	—	73,525	66,500	62,850
Charcoal	Bags	136,372	15,277	101,614	11,837
Hides	Frasila	28,782	49,756	16,983	49,787
Skins	Score	20,757	61,308	25,903	112,757
Ghee	Frasila	558	1,648	561	1,658
Cattle, Sheep and Goats	Head	—	—	180,179	272,939
Pigs	"	492	1,169	651	2,133
Poultry	"	264,251	36,259	174,576	22,896
Eggs	No.	7,981,777	46,343	4,302,115	22,938
Miraa (<i>Catha Edulis</i>) ..	Tons	15,756	16,682	15,600	11,700
Sugar Cane	"	307	1,718	—	—
Sisal (Leaf)	"	—	—	11,076	} 279,496
Sisal (Fibre)	"	—	—	4,961	
Miscellaneous	"	—	2,355	—	2,687
			£1,189,145		£1,707,805

Famine Prevention and Relief

The Tharaka area of Meru district had to rely once again on food sent from other parts of the district but from April on was able to draw on the surrounding locations for food. The large quantity of root crops in the ground proved of great

use and were drawn on extensively. In Embu there was a general shortage of food early in the year as the short rains failed entirely over a great portion of the district. Swamp cultivation and food from the mist areas alleviated the position but food for sale had to be imported in increasing quantities until the long rains crop was secured. In this district efforts are being made to increase the acreage under cassava against the locust threat. In the early part of the year Nyeri district was in a poor way for food, Nyeri itself having experienced less than 16 in. of rain in 1949. Food relief had to be organized for the aged and infirm and communal work on the land provided in return for meal for the able-bodied females. Work on reclamation schemes for wages was laid on for the able-bodied males unable to pay for food, while provision of imported meal at many centres throughout the district was necessary for sale to those with money to buy it.

Food issued comprised 912 bags of meal to the aged and infirm, 1,257 bags to the women's work gangs and 6,600 bags to markets for sale.

In Fort Hall and Kiambu also maize and maize meal had to be made available by Control for sale to those in need of it in the early part of the year. In the Kikuyu districts little reliance can be placed on Cassava as a famine prevention crop. Firstly, it is not popular and at the elevations ruling over much of these areas Cassava does not thrive sufficiently well. Bananas must provide the main insurance against famine and more important still better farming methods designed to counter periodic drought conditions, which would include adequate soil conservation measures to retain what water is available, and the more general use of organic manures.

In Machakos it was necessary to maintain the food importation and distribution scheme, inaugurated in 1949, throughout the year. Schemes of work, mainly on dam construction, were inaugurated to maintain supplies of cash to buy food. The main cash income has been from sale of stock in the early part of the year and sisal latterly. There have been notable breakdowns due to failure of deliveries when special arrangements had to be made, but it can be reported that the efforts of all concerned have maintained a regular food supply through the trade, every grain of which has been paid for by the district.

Permits for imports of food and seed into Machakos totalled 241,696 bags, mainly maize and maize meal, compared with 68,868 bags in 1949.

In addition to the supplies obtained through Control, not much less than 100,000 "bags" were "head-loaded" into the district from other districts of Central Province.

In Kitui, food relief through normal trade channels rose sharply after June and reached a figure of 12,461 bags in December. The acreage of cassava in Machakos and Kitui, much reduced by the food shortage conditions, is very far from satisfactory and efforts to increase it are continually being made. Most unfortunately large importations of cuttings from Nyanza made little material difference to the position as large quantities failed to strike in the poor 1950 short rains.

Investigational Work

In the absence of both staff and funds, no development of the proposed experimental station at Embu was possible during the year, but several trials were conducted by the Agricultural Officers in charge of the Agricultural School and Embu district.

In two trials with sunflowers, the semi-dwarf varieties, Pole Star and Mars, outyielded Giant Black in both trials, and Jupiter, another semi-dwarf variety was superior to Giant Black in one trial. Details of these experiments are included in the report of the Senior Plant Breeder. Observation plots of Maunther castor gave results of some promise, but the spacing (3 ft. by 3 ft.) was too wide to give the best results. Observation plots of local cassava varieties were continued in order to select those best suited to the district and 25 mosaic-resistant hybrids received from Amani were planted for multiplication. A preliminary trial with

Burley tobacco at Kangano gave very promising results, yields of four varieties ranging from 3,700 to 5,443 lb. of green leaf per acre, and the quality of the cover leaf being good. Variety trials with *Arabica* coffee were planted at three localities. A variety trial with rice at Mwea did not effect any valid comparison of varieties as the seed was found to be impure but the average yield of 6,000 lb. of paddy per acre was very satisfactory.

Three grazing experiments have been begun, at Baricho, Kinyori Hill and Kianyagga, on a particular type of useless bush, consisting very largely of *Cymbopogon gigantis*, which covers very large areas in Mdia and Gichugu and is quite useless for man or beast. These experiments all consist of the following treatments:—

- (i) Rotational grazing alone.
- (ii) Remove all inedible material followed by rotational grazing.
- (iii) As (ii) 10 tons manure per acre.
- (iv) Cultivate, remove all original growth, plant improved grasses (Rhodes and Star).
- (v) As above 10 tons manure per acre.

Before beginning these experiments the plots were examined carefully and some sample cuts of 25 sq. yards each were made of the herbage on representative areas. Cattle, grazing through the thick growth, are able to obtain a little sustenance, and in some areas the tall *Cymbopogon* is absent. When sample cuts were made they were made in areas representing the extremes and the average, from appearance of each type. Inedible natural was then separated from edible and weighed. These samples were taken on Baricho and Kianyagga only, as Kinyori was begun too late.

The results are available in detail from safari reports. At Baricho inedible material averaged 43.7 lb., with maxima and minima at 132 lb. and $\frac{1}{2}$ lb. while at Kianyagga it averaged 7.7 lb. maxima and minima 11 lb. and 2 lb. Edible material from plots of the same size 1.2 at Baricho maxima and minima $7\frac{1}{2}$ and nil and a trace in one of the three plots at Kianyagga. The sum of these figures shows that:—

- (1) At present, over most of these areas over 95 per cent of the herbage is inedible by cattle (97 per cent Baricho, 99 per cent Kianyagga).
- (2) That the soil is capable of producing up to 132 lb. on 25 sq. yards, i.e. a yield of over 10 tons per acre of inedible material, and therefore presumably a comparable weight of edible material.

The results were, it must be noted, obtained at the end of a drought, and cuts in the rains would give a higher percentage of edible material.

Of the treatments applied, the results from (v) have been the most spectacular, at Baricho and Kinyori there is now a practically complete cover of Star grass where formerly there was useless bush. The grazing equivalent has been, and it is estimated, increased from one beast per 20–50 acres to one beast per acre. Other treatments have also produced an improvement. The experiments are being grazed by cattle already in the improved plots and the number of cattle days are recorded. Results so far are as follows:—

	BARICHO	KINYORI					KIANYAGGA				
		i	ii	iii	iv	v	i	ii	iii	iv	v
September	No grazing to date	4	8	15			4	6	8		
October		12	23	24			4	16	16		
November		20	31	16	10	20	8	14	16		
December		16	32	32	16	32	16	23	29		
TOTAL		52	94	87	26	52	32	59	69		

These results are unsatisfactory since the plots were not grazed right down. The effect at Kinyori on (v) for instance was barely noticeable at all. Next year the results should be worth more.

At Kinyori at present there are eight cattle grazing on $7\frac{1}{2}$ acres of the total area of 10 acres. At Baricho sample cuts were made, these average out at: (edible material) treatment (i), none taken; treatment (ii) 12 lb.; (iii) 18 lb.; (iv) 39 lb.; (v) 83 lb. (maximum from this treatment, 160 lb.).

At Kagochi, in Nyeri district, work in connexion with the production of vegetable crops for canning showed that excellent yields of green beans suitable for canning could be obtained. Several varieties of celery which were tried produced heads of excellent appearance but suffered badly from "heart-rot", which may be due to boron deficiency.

In the Fort Hall district a small farm in the high altitude area, at Githuamba, has been loaned for experimental work by Chief Njiri. The first year's results were disappointing with almost all crops, and trials to determine the nutrient deficiencies of the soil are planned.

An Agricultural Officer was posted to Machakos district in the later part of the year to take charge of experimental work chiefly directed towards the establishment of grass leys and the production of fodder crops for dry season feeding. An experiment is in progress at Makabete to investigate the best combination of preparatory cultivation and grass species for ley establishment on eroded land with a hard surface crust in areas of relatively low rainfall. Three-inch surface scarification, contour ploughing, ridging and an application of dung at 6 tons per acre were factorially combined, with the use of two planted grasses (*Cynodon plectostachyum*, *Panicum coloratum* var *makarikariensis*) and two sown grasses (*Chloris gayana* and *Eragrostis curvula*). All plots were split for deep ripping versus no deep-ripping. Results are as yet by no means complete but good stands of *Chloris*, *Panicum* and *Cynodon* have been established under some treatments, whereas *Eragrostis curvula* has proved a failure. Deep ripping had an adverse effect and significantly reduced soil moisture. Ridging was beneficial and had a significant effect in conserving soil moisture at the base of the ridge.

Five exploratory experiments in the form of 4 by 4 Græco-Latin squares were put down in the short rains to test the effect of (a) 0, 4, 8 and 16 tons of dung per acre, and (b) nurse crops of Bulrush millet, sorghum, cowpeas and cassava, on the establishment of undersown Rhodes grass. The nurse crops failed owing to the extremely poor short rains but the manure had a marked beneficial effect on grass establishment at all centres. Yields of grass will be recorded, and, in view of the failure of the nurse crops, the experiment will be repeated in 1951.

An experiment to determine the effect of Agrocides 3 and 7 as an ant repellent when applied to plots sown to grass seed failed and will have to be repeated. Another trial is in progress in order to try and find a means of accelerating natural regeneration on worn-out eroded land. It combines no cultivation, surface scarification, and scarifying plus ridging with the fertilizer treatments O, N, P and NP. No results are yet available.

An exploratory experiment aiming at determining the most promising fodder crop and at examining the nutrient status of the soil took the form of a 4 by 4 Græco-Latin square with bulrush millet, maize, sorghum and Sudan grass as four fodder crops and the fertilizer treatments O, N, P and NP. Fertil results are not yet available, but maize and bulrush millet out-yielded sorghum and Sudan grass.

Progress in Improved Farming

Steady progress has been made in the direction of improved farming. Climatically 1950 was a more fortunate year than 1949. It is however, still most rare for two or three good seasons to follow one another and if this were to occur there is no doubt the progress made in better farming methods would be

hastened and more noticeable. Once again the greatest progress is reported from Nyeri district, all the more outstanding as three years ago it stood quite definitely at the bottom of the scale as far as the three Kikuyu areas were concerned. Similar results could no doubt be obtained elsewhere if the staff was available.

The value of grass is now much more widely appreciated and the writer was immediately struck by the large increase in paddocking on his return from seven months overseas leave. In the North Tetu Division of Nyeri the organized sale of milk to an organized Dairymen's Co-operative Society has provided an outlet for the product from the areas laid down to grass. The practice of applying manure is undoubtedly very much on the increase and progress, in varying degrees, is reported from all districts. The demand for manure in each of the Kikuyu Districts is immense and, as the price of imported goat manure from Masai rises, cultivators are turning their thoughts more to the local product. The number of cattle sheds in use is vastly greater than hitherto and both in Meru and Fort Hall the compost-making schemes have turned out very useful organic manure.

In all districts, however, the obstacle of the present land tenure system and fragmentation is regarded as the most important single item retarding progress in better farming. In this respect the results of the Agricultural Census revealed some interesting facts which certainly bore out previous suspicions. Cases came to light in which a single cultivator possessed as many as 25 holdings, 20 miles separating the most distant from the homestead. Little real progress can be achieved until some form of consolidation of holdings is effected, and only when security of tenure is assured will farmers be prepared to put in permanent improvements to their holdings.

Meru.—The Compost Instructors in Chuka and Mwimbi have made significant progress and there are now very many people who regularly use manure on their shambas. The failure of the November rains provided an opportunity for all instructors to demonstrate the value of manure by showing the striking results from shambas which had been manured compared with the complete crop failure where manure had not been used. A short boma building course was run in Chuka and Mwimbi towards the end of the year and much propaganda has been directed towards the end of getting more manure on the land.

A number of farmers have been chosen for intensive help. These people, apart from being better than their neighbours, have been chosen as typical farmers of the district. Those with any other source of income have been avoided. It is hoped that the obvious profit that these people derive from our teaching will serve as an example to their neighbours. The fact that the chosen few receive no help, except advice on cattle boma building, manuring, Kikuyu grass planting, paddocking and deticking of stock, will help to counter the criticism of our Seed Farms that their methods are impracticable for a man with little capital working on his own.

A communal effort by about 20 families to bench terrace some land on a slope otherwise too steep to cultivate has now been completed. This land belongs to three men and the families who did the work are getting three years' use of the land in return for their labour.

Embu.—It has not been possible to make much concrete progress this year for staff reasons. Thirty-nine new people joined the manure scheme but these were partly counterbalanced by the fact that some of those who joined last year have made little attempt to put into practice advice given to them, and have had to be subjected to pressure. The total area of land affected by the manure scheme is about 400 acres. There is, of course, a much larger acreage of land which is manured, usually rather inefficiently and with a poor quality product. There are also a number of individuals making paddocks, and running smallholdings without any monetary assistance.

The Gaturi Farmers' Society appears to be genuinely desirous of improving its farming practices and a number of its members joined the manure scheme. Unfortunately, the extreme earliness of the long rains prevented the supply of manure

to some of them in time for the crops. They appear to be ready to listen to advice and have made no objections to paying back their manure loans. *All* the members have applied to enter the manure scheme next year. Kyeni Farmers' Society has, however, done nothing to improve the farming practices of its members and is now more or less in abeyance.

Arrangements have now been made whereby a sum of up to £50 can be borrowed by a recommended person for the purpose of developing his land; several people have come forward to take advantage of this.

Unfortunately, any progress in improved farming is more than counter-balanced by the increase in the worst possible type of cultivation which has taken place in the last two years. Very large areas, totalling certainly more than 10,000 acres, have come under the plough in the Mwea plains and the grass woodland country of lower Gichugu and Embu, carried out by people who do not live anywhere near. The general effect is to destroy valuable grass cover on land not really suited to cultivation, but which will give good crops only while in a virgin state as at present in a year of fair or good rainfall. Many thousands of acres of valuable grassland will have been destroyed for ephemeral profits which could have been multiplied many times by paying adequate attention to the principles of good farming in areas higher up.

Nyeri.—The year 1950 can well be described as marking a general and widespread advance in the standard of husbandry. There is still a certain amount of stupid opposition from the malcontents who are always with us, and the young "spiv", but in general the people have been co-operative and receptive to an unusual degree. It is most satisfactory to record that the attention paid to the "commercial" agitator class has been increasingly poor. Notable advances have been in:—

- (a) The very rapid growth of paddocking and the appreciation of the value of grass as a *crop*.
- (b) The use of manure and construction of cattle sheds for composting crop residues, weed, etc. The Chief of Othaya Location boasts that there is no single cattle owner in his Location who has not a cattle shed in use.
- (c) The spectacular popularity of bench terracing—the figure of 29,643 running yards (an average width would be about 8 yards) gives an idea of the progress during the year. It was the demonstration at the Nyeri Agricultural Show in September which really stimulated the recent rapid development. An important feature of this work is that it is considered essential by all bench terrace owners to dose them liberally with manure.
- (d) Row planting on the contour (though still at times at right angles to it). The provision of a number of contour markers to the Locations has encouraged this considerably.
- (e) The rapid development of cash crops—tea, coffee, and pyrethrum, which are all becoming increasingly popular. Pyrethrum is taking on in a remarkable way now that cash is beginning to trickle into the pockets of the original planters.
- (f) The placement method of manuring, giving greater economy and used especially in potato culture.
- (g) General conservation measures, including terracing and mulching, which is no longer confined to cash crops such as coffee.
- (h) Penning of cattle in movable folds with a view to raising the carrying capacity of pasture lands.
- (i) Planting and care of trees.
- (j) Interest in water conservation by means of dams and wells. Opposition has almost died away during the year.

- (k) Readjustment of land tenure. In parts of the district success has already been achieved in getting the clans to effect exchanges so that farmers have composite holdings. If the fragmentation problem can be overcome, a really great advance will have been made. At any rate, there is now a ray of hope in Nyeri. This problem can only be solved satisfactorily by the good-will of the people themselves.

Fort Hall.—There is a marked increase in the number of paddocks being made in the higher zone and it is by no means unusual to find that land on which wattle has been felled, and which, in the past, has been allowed to regenerate, is now planted to grass and fenced. There are still vast areas of potential grazing under bracken but proposals are in hand to canalize the manpower of the upper areas towards communal bracken clearing and individual paddocking in place of terracing.

We still have distressingly few farmers whose holdings can be described as economic holdings but there is an ever increasing number of those who are progressing, albeit slowly, along improved lines. Few African farmers have the ability to tackle more than one progressive idea at a time with the result that it may take years before any marked improvement in the whole holding can be seen.

Cattle sheds are on the increase and there is considerable improvement in the bedding down of cattle and in the composting of the bedding. To say that the Fort Hall Kikuyu is becoming manure-minded is to understate the fact. He clamours for more and more manure. The cost of imported manure and its scarceness is making him turn to his own cattle for his requirements and any advice on how to increase his output is welcomed—provided too much hard work is not involved.

Compost making, in “frames”, is going quite well and when properly done will produce a lot of good-quality material. The filling of the “frames” is somewhat slow and not all that it should be even at schools where many children, bringing a little herbage daily, could fill a frame in 2 or 3 days. However, these are teething troubles which will be got over in time.

Machakos.—Severe drought conditions resulting in food shortage and lack of staff in the field both hampered progress in better farming methods. The main efforts of our staff were concerned with relief works of an agricultural nature, such as the construction of small dams, etc. Work on water supplies is undoubtedly vitally necessary for without adequate water supplies the wastage in manpower, or rather womanpower, is enormous. Nevertheless, the introduction of a better farming system, to counter the effects of drought, is the prime need of the district and this should run parallel with any other work undertaken. In this connexion, the correct crops for the area must be chosen and encouraged, not regardless of African prejudices but perhaps giving this aspect rather less consideration than it has received in the past. The correct management of the stock and their feeding in this dry area, must also receive close attention. These and many other problems connected with soil fertility must be dealt with and this can only happen, if adequate staff in this department is not only made available but retained in Machakos district.

Kitui.—Progress in this direction is very slow and is bound to be so for some time to come. The reasons include fragmentation and land tenure problems, the Wakamba practice of pasturing stock away from holdings, lack of suitable transport for manure, and the difficulty in growing adequate food supplies. A few individuals are trying improved methods, and there is a noticeable improvement in ploughing which is being done roughly on the contour. Propaganda directed at the abandonment of crops unsuitable to the district appears to have had some measure of success. There was a noticeable decrease in the amount of maize planted during the November rains, and a corresponding increase in mwele.

Soil Conservation

District	Miles terraced	Acres terraced	Grass planted Acres	Areas closed to grazing Acres	Grassed Runways	Compost pits used	Cattle Sheds used
Meru ..	1,374	7,557	2,623			31,401	
Embu ..	3,740	18,757	1,636				
Nyeri ..	3,373	9,903	3,772		3,111		7,078
Fort Hall ..	3,432	12,081			203	1,882	1,536
Kiambu ..	2,987	10,355					
Machakos ..	4,845	19,380	3,536	80,142	126	264	
Kitui ..	683	2,732	82	645	14		
1950 ..	20,434	80,765	11,649	80,787	3,454	33,547	8,614
1949 ..	19,174	80,933	5,614	81,270	3,001	20,820	21,069

In addition to the above, 218 miles of terraces in Nyeri and 507 miles in Fort Hall were constructed by paid gangs.

Terracing.—The excellent figure of miles terraced in 1949 was passed by a small margin, namely, 6.5 per cent, which shows quite clearly that the rising impetus during the past few years, which rose rapidly to a peak in 1949, is being maintained. There are prospects, in some districts, that it will be possible, in certain areas, to relax the effort on new terracing and concentrate on the maintenance of past work. This latter work will never cease, if the terraces are to remain efficient, and realizing this African cultivators are rapidly taking more interest in bench terracing. The maintenance of old terraces, on which pressure has to be brought to bear each season before crops are planted, has been reasonably good.

Meru.—Terracing during the early part of the year was mainly carried out on sites located by the Chiefs and Divisional Instructors for the opening of new *shambas* during the short rains season. From June-July into October the main terracing campaign was carried out and propaganda was intensified so that by the end of the year, 1,374.3 miles of terraces had been built, twice any previous annual record for the district. The system of terracing in relation to the natural features of the land was continued, and it has been found that not only does this system work better with the communal organization, but better work is carried out and the terraces last longer.

Embu.—There was a considerable increase in the total amount of work done over 1949. The fact that there has been this increase in spite of a reduction in the amount of supervision available is very creditable to all concerned. Maintenance of existing terracing has been satisfactory, and greatly facilitated by the laying of trash lines above the terrace channel.

Nyeri.—The clans deserve high praise for their patient endurance and sustained effort. The total amount of terracing is less than for 1949, but though some locations have not put up such sensational figures, the average has been much higher, with the backward locations of Muhito, Aguthi and Kirimukuyu now keeping up to, or near to, target figures. Some locational targets have already been substantially reduced as clans have completed their terracing programme.

Fort Hall.—As a result of setting targets, the 1949 improvement has been maintained during the year under review, except for seasonal declines. Location No. 8 (Chief Ignatio) is to be congratulated on achieving 102 per cent of its target and several Matura in this location should complete their terracing in 1951. Terracing continues to be on an individual basis and the standard maintained is satisfactory on the whole, if not fully up to the specifications demanded.

Kiambu.—Individual work on terracing was begun in May after group work had proved to be no longer practical. It was a popular move and at first looked as if it would prove a satisfactory substitute. Soon, however, the defects became obvious, the degree of supervision that had been possible with group work could not be maintained with individual effort and as a result, the standard of terraces fell off rather badly in many areas. This is a pity now as some other arrangement will have to be made for more effective supervision.

Machakos.—It must, unfortunately, be stressed that the terrace mileage figure for Machakos district is under considerable suspicion as sufficient check on the instructors figures was not possible. Furthermore, the type of terrace constructed is well below the standard accepted elsewhere and in this, of all districts, a high capacity terrace channel is required.

Kitui.—Terrace mileage in 1950 showed a decline of 417 miles compared to 1949. This was due largely to counter claims for dam construction, the absence of male labour owing to the drought and the fact that the Kitui Akamba still see little profit in this work. Greater concentration on the arable areas is necessary and if communal work on eroded grazing is undertaken, firstly the terraces must be planted to grass and, secondly, the area must be closed until it has recovered.

Bench Terraces.—The main attraction of bench terraces to the African cultivator lies in his belief that maintenance problems will be reduced to a minimum. At present, bench terraces are intended either for permanent crops or, assuming this is possible, permanent arable cropping with very liberal dressings of manure. In this connexion it is interesting to record that in Nyeri District, particularly, no person would consider constructing bench terraces without applying adequate manure to the land. A definite determination to improve the fertility and value of the land is thus being engendered.

In Fort Hall some 79 individuals dug and constructed 5.7 miles of benches—an average of 127 yards each—whilst schools produced a further 6.1 miles. The total for the year was the same as in 1949 in which latter year, however, the total for individual as opposed to school *shambas* was 1.8 miles only. In Nyeri 16.8 miles of benches were dug and this form of conservation has caught the popular fancy in a remarkable manner. Increasingly rapid progress is expected and our Leveller Staff will be much in demand. In Embu a few individuals have taken up this method of protection and 4 miles were dug and constructed. Meru reports the first signs of interest in benching.

Reclamation.—In the Mwea area of Embu, about 1,200 acres of eroded land were ploughed and planted to grass. The grasses sown were *Latipes*, *Eragrostis superba* and *Cenchrus ciliaris*. Unfortunately, there was little rain and germination was very poor.

In Nyeri district the paid gangs employed to deal with the most difficult areas did excellent work and completed a total of 217 miles of terraces. Similar gangs in Fort Hall completed 507 miles and did good work, particularly in the Maragua Valley. Comparatively small areas in Machakos district were tackled. In Kitui, a certain amount of reclamation of eroded grazing in the form of terracing was undertaken. Both in Kitui and Machakos it is planned to plant up seriously eroded and gullied land with sisal as only in this way can the land be effectively closed to stock. Incidentally, at present prices of sisal, considerable revenue should accrue from these otherwise worthless areas.

Grass Planting.—With the exception of Ukambani, 1950 provided far more opportunity for successful grass planting than 1949. In Meru, considerable areas of bare hill sides, cattle tracks, etc., were dealt with and in Embu, apart from the work mentioned in the previous section, particular attention was paid to village sites. In Nyeri, grass is looked upon as a valuable crop and apart from excellent work by individuals, it was possible to plant up large areas of land terraced by the paid gangs. Little of the plantings in Fort Hall or Machakos survived the end of the year.

Bush Clearing and Improvement of Pastures.—In Meru, over 4,000 acres of useless bush were cleared and developed as grazing and most Chiefs gave their active support to eradicate Mexican Marigold. In Nyeri, the famine works gave a fillip to the clearing of bush. The general condition of the enclosed pastures in this district is excellent and the large areas of green sward, free from weeds, would be the envy of many an English dairy farmer. Provided the livestock side receives the attention it deserves, grass has come to stay. Progress in Fort Hall and Kiambu lags behind but it must be remembered that these districts have had little veterinary attention until recently. If there is a serious lag between the production of good grass and the provision of an economic beast to consume it, land will revert to arable farming entirely on a wasting economy.

Tree Planting.—Recorded issues of trees by the department were just under the million mark in 1950. In actual fact, the figure probably greatly exceeded that given. In all districts the demand exceeds the supply.

Water Supplies and Protection of River Banks.—The very necessary protection of river banks and spring heads is given considerable attention and if this is relaxed very quickly trouble occurs, particularly in drought years when cultivation tends to drop lower and lower towards the valley bottoms.

During the year No. 1 Dam Construction Unit of the Soil Conservation Service finished off its tenth dam in Machakos and constructed four more. The total now stands at fourteen. Similary with ox-made dams, the main effort has been in the arid Kamba districts. In Machakos, an eighth unit was put into the field in February, 1950. During the year nine dams were completed and at its close eight others were under construction. Lack of water and grazing seriously held up work with oxen and progress was therefore slow. In Kitui, the very active campaign by the Administration resulted in the construction of 55 medium and small earth dams which is highly satisfactory and will go a long way to easing the acute water problems of that district.

Agricultural Education

PROVINCIAL AGRICULTURAL SCHOOL, EMBU

Sixty apprentices started the academic year, 1950, 28 in the second year of the two-year course, 25 in the first year and six undergoing the one-year certificate course.

Twenty-four of the first-year apprentices completed their year successfully and will return to finish their course in 1951. Twenty-six of the second-year apprentices were considered to have reached a high enough standard to be awarded certificates. All the second one-year course pupils were successful.

One of the encouraging things about the work during the year was the fact that it was possible to begin to give a coherent picture of the practical side of agriculture. This was possible through the development of a small part of the farm, use of the seed farm, and through a limited number of excursions.

EDUCATION DEPARTMENT AND MISSION SCHOOLS

The improvement in agriculture as practised on school plots reported in 1949 has continued and a keen competitive spirit has been encouraged in several districts. Some of the demonstrations afforded are excellent and the introduction of bench terracing through the medium of the schools proceeds apace in Nyeri and Fort Hall. As so many schools have been sited on unpromising land, the full development of the holdings is frequently a slow business. Perimeter fencing is still far from perfect and adequate internal fencing of the individual paddocks is still the exception. The number of schools possessing or having the use of cattle does, however, increase but where this is not possible, manure is frequently brought by the children, or compost made.

Successful refresher courses for teachers were held at Embu and Kiambu. Meru and Nyeri also arranged similar courses but these included Chiefs, Agricultural Instructors and progressive farmers as well as teachers.

Young Farmers Clubs.—"Young Farmers" is really a misnomer for the ages of members, as one district reports, range from 8 to 80. However, the title is retained for all are young in farming knowledge. Experience has shown that the inclusion of the older progressive farmers, with their experience and greater stability, has been highly beneficial. In Nyeri, the movement is developing steadily and with the appointment of a Specialist Officer in the person of the D.O., (C.D.), there should be greater progress and enthusiasm. The more successful farmer members take turns in entertaining the Clubs on their holdings where they have the benefit of practical demonstrations.

Agricultural Literature.—District newsheets are now prepared regularly in Embu, Nyeri, Fort Hall, Kiambu and Kitui districts. These form an excellent medium for disseminating items of interest, articles, etc., and all departments contribute to them.

Agricultural Shows.—Satisfactory long rains permitted the three agricultural shows planned for the Province to take place, that is in Nyeri, Fort Hall and Kiambu districts. Each one of these shows was an outstanding success and evidence goes to show that each successive year will see further improvements. Many districts sent conducted parties to the Nakuru Show which enabled at the least the more progressive agriculturists in the parties to pick up information of use to them.

Pests and Diseases

VERMIN

Poisoning gangs work in many districts and are in much demand for the destruction of porcupines, wild pig, ground squirrels, etc.

PESTS

Army Worm.—Appeared in Lower Chuka and Mwimbi in Meru and also in Embu but quickly disappeared. The infestation which occurred in the Weru country of Embu district in 1949 has had a serious effect on the grazing which had, prior to the very poor rains, been burnt.

Locusts.—No locust swarms appeared in the province during the year.

Plum Borers.—Although still present in the Tusu area, were less prevalent than in 1949.

Stalk Borer.—Caused considerable damage in locations 7 and 8 of Fort Hall, and in short rains maize in Kiambu. Elsewhere incidence was not high.

Pests of Coffee.—Antestia was recorded in Igoji, Meru and Ngandori, Embu, but responded to treatment. Several coffee trees were killed in the Chogoria area of Meru by *Asterolecanium* and it was necessary to stump a few more affected trees. Leaf miner appeared in certain coffee locations in Meru but with little serious effect. Coffee mealy bug occurred on isolated trees in each of the three coffee districts, being more troublesome on young Nyeri coffee, but was brought under control. Green scale frequently occurs on young coffee trees and in nurseries but responds well to treatment. Thrips on coffee were successfully dealt with by spraying in the Chuka area.

DISEASES

Fusarium Wilt.—Was evident in Embu, Machakos and Kitui districts. Its persistence in these districts occurs because cultivators will not go to the trouble of removing the old stumps, an operation which requires a certain amount of strength.

Hemeleia.—Occurred rather rarely on trees in Meru which had been allowed to overbear.

Maize Leaf Streak.—Was evident in Embu district but not on a large scale as occurred in 1947.

Mosaic.—On Cassava is always apparent. Kitui reports a high incidence no doubt due to the added effects of drought.

Potato Blight.—Was very widespread in the long rains in all districts where potatoes are grown. Conditions for its incidence were ideal and severe loss of crop resulted. The potato variety 914, which is alleged to be resistant to blight, was also affected and is now losing the popularity it once enjoyed.

Noxious Weeds.—Eradication of Sodom Apple and bracken was carried out over wide areas in Meru and Nyeri districts, but campaigns to reduce Mexican Marigold were less successful. Although *Datura* is still seen occasionally, the response to our efforts to eliminate it are quite good.

The Agricultural Census

Little political trouble was experienced in undertaking the Agricultural Census except in Ch. Waruiru's location of Kiambu where it was decided to abandon our work. Long rains crops were generally well above average in the yields they provided and thus the figures obtained over this one year are of little value in presenting a true picture of normal returns from the land. Similarly, in the short rains, yields were seriously reduced by poor climatic conditions though in this case one regards a partial failure of the short rains to be almost a normal occurrence these days. Very interesting but equally alarming evidence of the degree of fragmentation was obtained from the Census and this has set officers once more on to the problem of its solution.

General

The year commenced with the food reserves of the Province at a very low ebb and a number of districts were importing food for sale to those in need of it. It was, therefore, with considerable relief that the long rains, which broke early, were received. Unfortunately, these rains, which elsewhere were well above average, did not extend in full measure to Ukambani and both Machakos and Kitui districts went through a very difficult year. Elsewhere, very satisfactory progress, both with soil conservation works and the introduction of better farming methods, was made. There is, however, a wide difference in the approach to these two main activities of the department. With soil conservation, our primary aim is to get the land protected and both during and after the process persuade the occupiers of the land that the measures taken are to their profit. This the average African cultivator appreciates though naturally he dislikes the work involved. On the other hand, to persuade primitive agriculturists that better farming pays, and by this term is meant the combination of a number of practices alien to him, is no very easy matter. Progress in mixed farming practice cannot be ordered but must be induced by educative means; even in countries of progressive agriculture there will always be some bad farmers. Considering these difficulties and the many others that arise in any African Land Unit, particularly that of security of tenure, it is gratifying to see, if only a small proportion of the cultivators, making some real effort to improve their lot. Future progress in this direction will, however, be retarded unless the questions of land tenure and fragmentation are solved at an early date.

The staff of the Province, both European and African, is to be congratulated on the progress made during the year, in spite of the considerable disturbance to staffing occasioned by many officers proceeding on leave.

Finally, the co-operation and assistance of the Provincial Administration is acknowledged and they are sincerely thanked for their understanding and sympathy with the common problem of correct land use.

J. T. MOON,
Provincial Agricultural Officer.

ANNUAL REPORT OF THE PROVINCIAL AGRICULTURAL OFFICER, COAST PROVINCE, 1950

Seasonal Conditions

The long rains broke in the middle of March in most parts of the Province and in the Coastal Belt and the Teita Hills continued satisfactorily during April and May and then abruptly ceased during the first three weeks of June throughout the Province. This rainless period was accompanied by high drying winds which caused below average yields of early planted maize. However, in the Coastal belt useful falls during July, August and September resulted not only in a bumper cotton crop but a very useful harvest of later planted annual food crops. The short rains were patchy and unreliable and must be counted as a total failure in some areas, whilst in others they were no more than barely adequate.

RAINFALL

	1949	1950		1949	1950
	<i>in.</i>	<i>in.</i>		<i>in.</i>	<i>in.</i>
Lamu	15.66	27.24	Gazi	28.75	37.41
Kipini	17.14	27.21	Kinango	17.39	26.37
Malindi	21.10	34.42	Vanga	26.11	35.70
Kakoeni	15.33	23.89	Mariakani	15.80	28.63
Marafa	22.76	20.49	Samburu	13.19	20.63
Kilifi	25.27	37.87	Mackinnon Rd.	9.16	15.12
Bamba	11.86	27.04	Voi	12.15	13.58
Kaloleni	31.75	33.12	Wundanyi	38.15	48.92
Mombasa	28.49	36.03	Taveta	10.45	22.08
Kwale	30.13	43.37	Gede	17.95	30.08
Tiwi	26.30	21.11	Ramisi	35.84	40.98
Msambweni	31.61	53.82			

Production

CROPS

Beans.—Teita Hills is the only area where this crop is grown to an appreciable extent and fair yields were reaped from the 1949–50 short rains crop. Long rains crops planted in March and April gave very good germination and it was estimated in June that there would be a total yield of 12,500 bags available over a period of several months. It is very difficult to give accurate yields as a large percentage of the crop is sold as green beans in Mombasa.

Cashew Nuts.—Buying of the new crop in December totalled 540,420 lb. of nuts at a price of 10 cents per lb. to the producer. The expansion of home processing of nuts for the Mombasa market accounted for 15 per cent of the crop, 65 per cent going to the Kilifi factory and the remaining 20 per cent being left on the ground unharvested. Production could readily be doubled by careful cultivation and the exclusion of fires. New cashew nut legislation was successfully applied during the year. At Kibarani and Gede selected seed has been collected for planting within the district in 1951.

Cassava.—With the danger of locust invasion propaganda continued throughout the year in an endeavour to get this crop established throughout all districts. Success varied. In Digo cassava has been for years the main crop and there is a considerable acreage under cultivation. Really large-scale plantings have taken place in the south-western portion of the Kilifi Reserve. Little progress however has been made in the hinterland of either Duruma or Kilifi, partly due to lethargy and partly to climatic conditions and the difficulty of arranging adequate planting material. During the year under review the prices to the growers varied from 5 to 10 cents per lb. of dried cassava.

A severe attack of Brown Streak unfortunately occurred on a large European-owned estate in Kwale district and severely affected yields and more particularly quality. An effort is being made to re-establish with varieties which appear to be resistant to this virus. Brown Streak is rife throughout Digo district but has not yet been identified in Kilifi district.

Chillies.—189,392 lb. of chillies were exported during the year from Voi district where they constitute the main source of cash for the people in the lower country, particularly Mwatate and Kasigau. This figure shows a slight improvement of production over the 1949 figure. The bulk is sold through co-operative societies. With the introduction of the Chillies Grading Rules the quality of chillies offered for sale has improved considerably. The average price to the grower was Sh. 1 per lb. Sales direct to Mombasa from other districts are small and untraceable.

Coconuts and Copra.—Sales of copra dropped to a low level. This was partly the aftermath of the dry years of 1948 and 1949 and partly to excessive tapping of inflorescences for beer, to better relative prices for whole nuts, to lack of care of plantations resulting in severe damage by Rhinoceros Beetle, to failure to replace senile trees, and to fires. The Department started a vigorous campaign under the Coconut Preservation Ordinance to enforce the cutting down and burning of dead and dying trees, destroying immense numbers of Rhinoceros Beetles and their breeding places and the removal from *shambas* of rotting vegetation in which these beetles also breed. In Digo district 9,500 palms were destroyed. Nurseries have been started as part of a re-planting campaign in each district and at Matuga and seedlings will be sold at 25 cents each. In Kilifi 1,500 seedlings were issued to Africans for planting. Propaganda for this work was supported by mobile vans in Mombasa and by officers at *barazas* in the Coastal districts.

Produce Control purchased 1,181 tons of copra in the year ending 31st August, 1950, a drop of 662 tons on the previous year. The price to the producer ranged from Sh. 10/13 to Sh. 13/80 per frasila.

Coffee.—In the Teita Hills the year has not been favourable for coffee. With the 1949 short rains 245 seedlings and with the long rains 979 seedlings were planted out.

Enthusiasm for coffee planting remained insipid during most of the year with a consequent lack of care for plantations by the few people growing coffee. This would appear to be due to frequent changes of officers with a consequent lack of continuity, especially in nursery work; so bad has this been that there are no plants for issue during 1951. Nursery work has been restarted and there will be 100,000 seedlings ready for planting out in the long rains of 1952.

The Senior Assistant Agricultural Officer, Voi, through the courtesy of the Senior Assistant Agricultural Officer, Meru took a party of Wateita to study coffee growing by the Wameru. This left the Wateita with no illusions in regard to their own efforts, but has resulted in 340 applications to plant coffee.

The Government coffee plantation at Wundanyi itself has flourished throughout the year. Flowering was heavy during the latter part of November and on into December and small pickings have been harvested throughout the latter month. Seed of the varieties *Coffea arabica* (Selection K. 7), *Coffea robusta* (Spreading), *Coffea robusta* (erect), *Coffea Liberica*, *Coffea excelsa*, and *Coffea stenophylla* Nos. 1 and 2, has been received through the Coffee Research Station, Ruiru, and planted at Matuga. Seedlings will be issued to the Coastal belt later.

Cotton.—Final figures for the 1949–50 cotton crop were—

		A.R.	B.R.	Total
Malindi	.. ..	743 bales	167 bales	910 bales
Lamu	.. ..	15 bales	3 bales	18 bales
Total	.. ..	758 bales	170 bales	928 bales

In spite of the very poor return from the 1949-50 plantings due to drought conditions, enthusiasm was well maintained and a satisfactory acreage sown in 1950; germination on the whole was good. This enthusiasm had its reward in the shape of increased prices for both A and B grades and the perfect cotton season climatically. Yields have been far above average and pests and diseases conspicuous by their absence in the Kilifi-Malindi area, B grade promising to represent only 5 per cent of the crop in these districts, an unusually low figure. In Lamu and Tana River areas conditions were not so good. Early plantings suffered great damage from grasshoppers and several re-plantings were necessary before stands were obtained. The crop in spite of this will be the largest since the 1936-37 season. Quality has not been on a par with that of Malindi.

Buying started on 21st November and by the end of the year 4,479,497 lb. of "A" grade cotton had been bought. The total crop is likely to be in the region of 4,500 bales.

Fruit—Bananas.—Mainly grown in the Sabaki and Tana River areas and some parts of the back country it was the only fruit of which a considerable surplus was sold during the year, mostly in Mombasa. The banana is particularly suited to the riverine areas of the Coast but cultivation methods are haphazard. There are, however, many well-tended groves along the banks of the Sabaki River and fruit from these growers fetches up to Sh. 4 per bunch.

Citrus.—While the quality varies greatly and is generally poor, there is always a ready sale for oranges in Mombasa at prices in excess of what the produce is really worth. The Teita Hills crop, which is sold through a co-operative society, found its way to Nairobi. It is estimated that up to 50,000 hundreds were sold in Mombasa during the year. With a few exceptions no attempt is made to get quality lemons and grapefruit by raising good stock or tending the existing trees. Interest is being shown generally, however, in the production at Matuga of budded varieties of citrus fruit. There is enormous scope for the production of good citrus along the Coast and through Matuga this can be fulfilled. In Voi district some 1,000 rough lemon seedlings were raised in the Wundanyi nursery, these will be budded with selected varieties during the long rains of 1951 and eventually be issued to the Africans for planting.

Mangoes.—It was rather a disappointing year for mangoes as a very promising season was spoiled by the high winds in June which bruised the ripening fruit and quality was therefore useless for either export or local consumption. The planting of recognized varieties, e.g. Boribo and Ngowe still continue throughout the Coastal strip. This is no doubt due to the attractive price obtained for these varieties, which are extremely good, fetching Sh. 30 to Sh. 40 per 100 to the producer. The method of marketing still leaves much to be desired.

At Kibarani Messrs. Lillywhite & Gibson are undertaking canning trials with Boribo and if these trials prove successful it will be greatly to the advantage of both producer and canner.

Pawpaws.—The three Asian estates on the south coast which were originally established to produce papain continued to sell their crop as fresh fruit as the price of papain was not sufficiently attractive to justify production. The price rose, however, towards the end of the year and they once again started tapping for papain.

Passion Fruit.—The Teita Hills is the only area in which this fruit grows in the Coast Province. At Ngereni, Teita Concessions Limited have planted up a considerable acreage. The vines are properly trellised and well cared for. Considerable die-back occurred during the latter part of the year and the manager was advised to send plants to the Senior Plant Pathologist. Whether Teita Concessions will erect a juice extracting plant is still doubtful and on this hinges the development of passion fruit growing by the Wateita.

Pineapples.—The erection of a canning factory at Kilifi by Messrs. Lillywhite & Gibson stimulated considerable interest in pineapple growing in that vicinity.

Messrs. Teita Concessions Limited, who acquired 12,000 acres in the neighbourhood last year, have now got on well with development and have planted 70 acres of suckers. Several small-holders along the coast supply pineapples to Mombasa Fresh Fruit Market. Pineapple spacing trials are taking place at Kilifi.

Groundnuts.—Bambara is the more widely grown variety in the Coastal strip as well as in the native reserves and is consumed locally. The yield per acre was poor due to unfavourable seasonal conditions.

Kapok.—A considerable number of seedlings were raised and distributed in suitable areas during the year. Except for one large estate with 400 acres of Kapok trees in bearing and 175 acres under young Kapok, production is mainly from the Gede Settlement and from scattered Arab- and African-owned trees.

Much of the crop is bought by Messrs. Malindi Gineries Limited who gin it, bale it and sell to exporting firms in Mombasa. Purchases in the last three seasons have been:—

		<i>Ginned Kapok</i>	<i>Price to the grower</i>
		<i>Lb.</i>	<i>Cts. per lb.</i>
1948-49	.. .. .	89,000	35
1949-50	.. .. .	140,000	35
1950-51	.. .. .	95,147	50

Buying has been on a more competitive basis in the 1950-51 season and prices varied from 50 cents to Sh. 1 per lb.

Legumes.—Cowpeas are grown extensively along the Coastal strip and also in the hinterland where they form a valuable cash crop. A good crop was harvested in Kilifi and Malindi areas during the year, but the long rains crop in Duruma was only poor. The crop stores badly and is eaten only on a limited scale by the Nyika. Demand both in Mombasa and outside is heavy, therefore a flourishing black-market has existed throughout the year with prices greatly in excess of those scheduled.

Maize.—Although it is clear that the Coast is not suitable for maize, it still remains the most popular food and it is planted on every possible and frequently impossible occasion. Most of the maize crop on the Coast is the multicoloured, low yielding deteriorated mixture of numerous varieties. A fair long rains crop was obtained in Southern Digo, while in Duruma and Northern Digo the crop varied from poor to a failure. The crop, however, did well on the north coast. In Voi, the short rains crop planted in August and September, 1949, was very light over both high and low zones. The long rains planting of 1950 promised well at first after good March, April and May rain but suffered a severe set-back during the following months and only in the high zone was the harvest at all adequate for the population. The Lamu and Tana River crop was merely fair.

Millets.—All millets are planted on a disappointingly small scale considering their suitability to local conditions. This is probably due to the fact that they have to be guarded against birds; in other words extra effort is required.

European Potatoes.—Only a small acreage was planted at Wundanyi and the yield was very poor due to the incidence of blight.

Sweet Potatoes.—Are grown over most of the Province but nowhere in quantities sufficient to provide an adequate food reserve except in the Teita Hills where an increased acreage under this crop is reported. The crop has done moderately well everywhere it was planted. Propaganda continued for increased planting of this crop due to fear of a locust invasion and this has borne fruit within limits.

Rice.—The main staple food in the Tana, Sabaki and Umba riverine areas. It is normally consumed within the Province. In Kilifi and Malindi the crop was below average partly due to the bad cultural practices but more so to both Lakes Baratumu and Jilore failing to fill with water as usual. The irrigated

rice of Uмба Valley in Kwale district did very well and about 14,000 bags of paddy were harvested from about 700 acres. Owing to the low control price of 13 cents per lb. for paddy to the producer most of the crop which was not consumed locally found its way to the black-market at 31 cents to 35 cents per lb. The Produce Controller's Agent at Vanga managed to buy only 30 bags during the year.

Simsim.—Only a small acreage of the black seeded variety was grown along the Coastal strip. Yields were moderate. It is disappointing to see how little interest is taken in this crop which formerly was very popular and is well suited to the light soils of the Coast. The whole crop was disposed of through the black market.

Sisal.—A European- and Indian-grown plantation crop which enjoyed a prosperous year. A considerable acreage of new sisal was planted during the year. Voi and Taveta have enjoyed a slightly better year than experienced in 1949.

Sorghum.—As most of the Coastal people prefer to consume maize the acreage under sorghum is unfortunately limited. The long rains, however, proved suitable for this crop and a good harvest resulted from the little planted. Efforts to popularize the proved short-term variety Dwarf Hegari have met with negligible success, partly on account of general preference for maize as a diet and partly owing to the necessity of bird scaring if any grain is to be harvested. The Dwarf Hegari sorghum generally does very well on the Coast and it is being bulked for augmenting future seed issues.

Sugar Cane.—The Kenya Sugar Limited had a successful year. Messrs. Kisiwani Estates Limited's application for more land to plant sugar at Kisiwani was still under consideration by the end of the year. They imported five lorry loads of variety C.O. 281 from Nyanza Province. This variety was considered to be more suitable for Coastal conditions. Large acreages of cane were grown in the Teita Hills and considerable quantities in other areas. Its main use is for making beer and it is indeed pitiful to see acres and acres of it under irrigation in the Teita Hills while at the same time the Wateita receive famine relief.

Tobacco.—Not of great importance except to Lamu district. At present this industry is a local one almost entirely confined to the villages of Siyu and Pate Islands. Tobacco has done sufficiently well both at Matuga and Kibarani to suggest that here is a crop which might well prove to be of considerable economic importance to the Coast.

Vegetables.—European vegetables are grown in the Teita Hills and are marketed largely by co-operative societies. These societies have been and are still going through a difficult time. Their trade in Mombasa has suffered a severe setback on account of the poor quality vegetables which they offer for sale and also for lack of variety and increasing competition from up-country. If the societies are to continue and vegetables from the Hills to regain some of their former position then there must be a quick change over to more rational plantings. The attitude "if you don't like my vegetables don't have them" cuts no ice as the Wakikuyu can supply better quality and variety to Mombasa at a price lower than the Wateita demand. Every effort is being made to get variety plantings but the cabbage complex dies hard. Export figures of vegetables for the whole of the Teita showed an appreciable increase over the previous year. These were:—

1949	1950
1,098,411 lb.	1,915,544 lb.

Considerable and increasing quantities of vegetables for Indian consumption are being grown under irrigation by market gardeners and smallholders on the Coast in close proximity to Mombasa.

Marketing

By the end of the year the proposed Coast Province Produce Marketing, Improvement and Inspection Rules still awaited the blessing of Government and, as in the previous years, organized marketing was only applied to cashew

nuts, cotton, copra and to a lesser extent vegetables and kapok. It would seem that the difficulties inherent in applying marketing legislation to this Province have in the past prevented any real attempt at organized marketing or improvement of agricultural produce. Admittedly the difficulties are considerable in that the Marketing of African Produce Ordinance can only apply to produce grown or produced by Africans and it would be invidious as well as impracticable to apply this or any other similar legislation to the inhabitants of one part of the Province and not to their neighbours on the other side of an arbitrary line. Unless the proposed Coast Province Produce Marketing, Improvement and Inspection Rules are approved and brought into force, the Province will always lack a complete and reliable marketing organization.

The Marketing Officer spent a considerable amount of time in an endeavour to straighten out the affairs of the Teita Vegetable Co-operative Societies..

The following table is of produce sold for export from the Province:—

Produce	Quantity	Approximate value
	<i>lb.</i>	<i>£</i>
Cashew Nuts 1949/50..	1,244,838	6,625
Chillies	189,392	9,470
Copra	2,647,232	43,973
Cotton 1949/50 A crop	1,003,018	} 16,845
B crop	236,135	
Kapok 1949/50 ..	140,000	2,450
Sisal	8,799 tons	897,675
Sugar	12,913,000	184,840

The following are estimates, except in the case of vegetables, and represent a redistribution of cash already in the Province, between one district and another, and in the main between the Africans:—

Produce	Quantity	Approximate value to producer
		<i>£</i>
Betel leaves ..		2,200
Cassava ..	375 tons	2,940
Coconuts ..	1,000,000 nuts	7,500
Cowpeas ..	12,000 bags (200 lb.)	24,000
Fresh Fruit ..	5,500 tons	55,000
Green Gram ..	2,200 bags (200 lb.)	6,600
Maize ..	15,000 bags (200 lb.)	15,000
Maize bran ..	24,000 bags (70 lb.)	6,000
Rice Paddy ..	15,000 bags (160 lb.)	30,000
Simsim ..	400 bags (180 lb.)	800
Sweet Potatoes ..	25 tons	125
Tobacco ..	35,840 lb.	1,792
Vegetables* ..	2,100 tons	52,500

*This includes vegetables produced by Indian market gardeners.

Famine Relief and Prevention

The precarious food position resulting from the chancy rains was helped by measures to check the usual practice of exporting excessive quantities of maize. Without such control food shortages would no doubt have been serious in all the drier areas. Planting of cassava, sweet potatoes and Dwarf Hegari sorghum continued to be encouraged as an anti-famine measure and a satisfactory response was made throughout the Coast to the planting of the two former.

The following amounts of maize or maize meal were imported into the Province during the year:—

	Bags
Voi	15,043
Kwale	25,932
Kilifi	74,643
Malindi	12,177
Tana River and Lamu	7,000
Total	134,786

It is significant that the needs of Kwale district were only about one-third of those of Kilifi. Better propaganda for the planting of cassava is not needed. Fortunate is Kwale indeed with its large acreage of cassava along its sea board.

Crop Improvement

Seedlings of B.R. II and S.L. 29 coffee and varieties 338, 261 and Kenya Governor of wheat were planted in the nurseries at Wundanyi.

Kibarani.—Crops bulked at Kibarani for later distribution were: Dwarf Hegari Sorghum, Tobacco, Bambara Groundnuts, Common Groundnuts, Durum Maize, Castor Oil.

With the exception of Bambara groundnuts, which gave good results, e.g. 863.3 lb. per acre, the rest gave fair to very poor yields due to lack of sufficient rains and high winds during the early stages.

Malindi.—Seedlings from good stocks of coconuts and kapok were grown and distributed.

Seed Issues.—

Yellow Durum Maize (bags)	67 ex-Kilifi
Banana suckers	29 ex-Matuga
Citrus seedlings	1,000 ex-Matuga
Coconuts seedlings	700 ex-Malindi
Cassava (lorry loads)	21 ex-Kwale
Kapok seedlings	500 ex-Malindi
Green Gram (bags)	20 ex-up-country

Progress in Improved Farming

The great difficulty in starting a manure scheme on a large scale is the prevalent Bantu superstition that if the manure is removed from the *boma* the cattle will die, which is still very much alive. Until this is broken down no great progress can be expected. Such superstition, however, can be overcome as indeed it has been elsewhere.

Unfortunately the ox-ploughs introduced last year to Duruma, in Kwale district, have not been in use during the year, excuse being that the owners had no trained oxen. It is easier for a woman to dig than for a man to train an ox.

Soil Conservation

Considerable progress was made in the closure to cultivation of steep sloping land. The Assistant Agricultural Officer, Kwale, started a system of teams with a view to inaugurating an all-out soil conservation campaign in the Mazeras and Duruma areas. The campaign met with excellent response and a great deal of work was completed within a very short time.

The laying of trash lines has gained ground throughout most of the Province and some improvement has been achieved in size and technique. While undoubtedly the trash line has been of enormous help, objections to this method include the danger of stalk borer from maize stalks, consumption of trash by white ants, damage by wind, fire or poultry and the need to realign lines annually. New methods being adopted permit of the stacking and burning of maize stalks, the

leaving of a 3 ft. uncultivated wash stop demarcated on the contour on which are placed all weeds and grasses. It is hoped that by these means stalk borer will be controlled, the contour line will be permanently demarcated, and a gradual building up of bench terraces will take place. A trial line laid a few months ago revealed a build up of 9 in. and grass was growing through trash in the line.

In Teita 1,530 miles of narrow base terraces were constructed to protect 3,444 acres. *Shambas* protected with trash lines totalled 11,529 in Kwale, 6,959 in Kilifi and 714 in Malindi. Much attention has been given to gully control in the Teita Hills. Although progress has been fair and 317 gullies were stopped, much remains as yet undone in the Hills. The serious erosion being caused to hillsides at Msau came under discussion at the meeting of the District Team in December. It was decided to make a full survey of this area early in 1951 with a view to moving cattle and putting reclamation work in hand over the whole area.

Water.—Dams and/or water holes constructed during the year include 21 in Kwale, 49 in Kilifi and 9 in Malindi district. Most of these dams and/or water holes were constructed by communal labour unpaid but rationed.

Agricultural Education

The Kibarani Agricultural Training School for Instructors continued to function during the year and 25 pupils were on the roll of whom 11 were first year and 14 second year students. Emphasis was again laid on practical work on the farm, in addition students were taken on safari by the Assistant Agricultural Officer to gain a working knowledge of routine Reserve work. Ten pupils who completed their course at the end of 1949 took up their duties as Agricultural Instructors in 1950. Eight of these were posted to Kwale district and two to Kilifi. A further ten left at the end of 1950 and will be absorbed in the departmental establishment in 1951. Throughout the Province Officers and Instructors visited schools and gave talks and advice on agricultural matters. Response from schools has been limited.

Communications

The Lamu-Tana River districts were as usual cut off for a long time while in Teita, Kwale, Kilifi and Malindi districts roads were good and passable throughout the greater part of the year.

Pests and Diseases

Pests recorded during the year were Aphids on brassicas in Teita Hills, Brown Scale on citrus, Banana Weevil in Kwale and Kilifi, Fruit Fly on young loofah fruits, Sisal Weevil for the first time, and diseases included Brown Streak and Mosaic on cassava, Pink Ear Rot in maize, Mosaic in tomatoes and Smut on sorghum. None of these reached epidemic proportions. Of the cotton pests and diseases, Jassid and Stainers were abnormally light while in coffee, of Hemileia, Yellow Headed Borer, Tip Stem Borer and Yellow Borer, only the last two caused serious damage in Teita. Appreciable to severe damage was caused by the Rhinoceros Beetle in coconuts and Stalk Borer in maize.

Vermin.—Four Vermin Control Scouts were employed in Kwale district during the year and they functioned with varying success. They accounted for a total of 50 wild pigs, 423 baboons, 187 monkeys, 26 wart hogs and 20 porcupines. In addition to the above the Game Control Officer was always available on call to shoot or control the elephants where they did damage to the crops.

Development

COAST INVESTIGATIONAL CENTRE, MATUGA

Good progress was made in developing the Coast Investigational Centre. A 10-acre irrigable nursery site was selected early in the year and of this about eight acres have been cleared and developed. An increase of approximately 70 acres for field trials was cleared to the south of farm buildings, and protected against soil erosion. Of this 12 acres are devoted to preliminary experimental plots and the remainder has been ploughed and planted to a green cover crop.

Roads.—All farm roads have been protected against erosion.

Water Supplies.—A pumping scheme, capable of delivering 2,250 gallons per hour was installed to raise the waters of the Mvura Mdogo stream for use in the nursery and for domestic purposes. The pump power-house and 3 in. rising main (1,200 yds. long with a total lift of some 350 ft.) were completed, and water for irrigation purposes is being supplied direct to a reservoir having a capacity of 100,000 gallons. The reticulation system, working off a 1½ in. main, was also completed during the year. A second pumping unit, consisting of a 10/2 Lister Diesel engine Evans Culwell 5×3 pump, was also installed for relief purposes.

Dams.—The dam on the Mvura Mdogo, above the pumping site was completed. The dam at crest level is 15 ft. high and will impound 5,500,000 gallons when full. It has not yet filled due to lack of rain.

Buildings.—Owing to the very slow progress in the erection of the houses and school buildings the Public Works Department were asked to undertake this work in June. The department completed the building of partially completed farm stores.

THE PROTECTORATE

Interest in the development of the Coastal strip appeared to be maintained. Teita Concessions Limited are busily engaged in clearing the 12,000 acres granted to them during the year and some 70 acres of pineapple suckers have been planted. Applications for other Crown Lands have been received, the largest of these being for 3,500 acres in the Sabaki valley by Kisiwani Estates Limited. The fact remains, however, that far too much land in the Protectorate belongs to absentee landlords who hold merely against a speculative rise in values.

AFRICAN LAND UTILIZATION

Teita Betterment Scheme.—Progress of this Scheme showed improvement.

Gede Settlement Scheme.—The settlers enjoyed a prosperous year. The Assistant Agricultural Officer in charge—Mr. York—achieved great success in well digging by communal effort and therefore the water position at Gede has been improved considerably.

Mijomboni.—The proposed settlement of Mijomboni is still suffering from lack of fresh water although all possible attempts have been made. A reception camp, comprising 12 Swahili-type houses, was built during the year and three tanks dug in Lake Baratumu, these however dried out and in consequence the arrival of Fort Smith Swahilis had to be postponed indefinitely pending arrangements for a fresh water supply. Enough land for 11 families was, however ploughed prior to the short rains, but remained unplanted owing to the failure of the rains.

Shimba Hills.—Towards the end of the year work was started on developing a demonstration area.

Hinterland Development Scheme.—This finally got under way about the middle of the year. A start was made in the Kilifi area where five small dams were built, three bore holes drilled, 30 miles of new road made and 60 miles of old roads regraded. The Works Supervisor and machinery then moved to Kwale during the second half of the year and remained there until the end of the year. As is usual with schemes of this sort initial progress was slow and teething troubles many. Latterly, however, work has been speeded up to a gratifying level.

Agricultural Show.

As this was the first Show to be held for many years it was decided to run an ambitious Provincial Show. Several cups were competed for, the main one being the Inter-District Cup presented by the Mombasa Chamber of Commerce and Agriculture. This was won by Kwale District with a very well set-up

exhibit. The Inter-Location competition was well supported and won by Ganda Location of Malindi. Great support was given to the Show by all races of the Mombasa commercial world and some of them actually put up exhibits. Prizes were entirely paid for by private donations. The Show was opened by the Provincial Commissioner, Coast, and the prizes presented by Mrs. Gillett, wife of the Director of Agriculture. The Director himself kindly acted as a judge. Several hundred Europeans and thousands of other races attended the Show, which according to press reports was a great success.

Investigational Work

At the Matuga Experimental Station, which is in process of development, the work so far initiated has been chiefly confined to fruit. A citrus orchard is being established containing 30 varieties of several species, chiefly oranges, with the object of selecting those varieties best suited to Coast conditions. In the meantime, in view of the big demand for citrus trees, budded trees of several promising varieties of orange, grapefruit, lemon and naartjes are being raised on a fair scale and over 10,000 stocks were budded in 1950, almost all with budwood imported from a reliable source in South Africa. Most of the budding is being done on Rough Lemon stocks but Sweet Orange is also being used to a limited extent in order to test the effect of this stock on the growth, yield and quality of several varieties. Propagation of good local mango varieties from seed was disappointing owing to the heavy infestation with Mango Weevil. Seedling stocks of the local "Dodo" variety have been raised for budding with budwood of improved Indian varieties which is being imported from South Africa. Observation plots of Cape Gooseberries under irrigation made very good growth. Variety trials with tomatoes and onions were largely abortive, the former due to virus disease and insect pests, and the latter owing to theft. Other work at Matuga included plots of various species of grasses and a preliminary trial of tobacco under irrigation, which gave promising results. Seedlings of five species of coffee (*C. arabica*, *C. liberica*, *C. excelsa*, *C. robusta* and *C. stenophylla*) were raised in preparation for trials to be planted in the low altitude districts. For the higher altitudes of the Teita Hills seedlings of various varieties of *C. arabica* were raised at Wundanyi.

A few simple trials were conducted at Kibarani. These included a spacing trial with cotton (unreplicated) in which the highest yield was obtained from the closest spacing, which was 1 ft. square with 4 to 6 plants per hole, a plot of Maunther castor oil, spaced 3 ft. by 1 ft., which yielded 300 lb. per acre; and a field of Durum maize, which yielded only 2.3 bags per acre owing to a combination of low rainfall, poor seed and poor soil.

General

The year was again one of very great difficulty with seasonal conditions continuing adverse and preventing officers from seeing adequate results for all their efforts. Nevertheless the continuous period of food shortage and stress were very much better than might have been the case. The Province as a whole experienced a period of marked prosperity and probably the majority of Africans in the Province have put in more work than in any previous year in one way or another.

In conclusion the ready assistance and co-operation of the Provincial Administration and the Department staff must be recorded and gratefully acknowledged.

G. J. GOLLOP,
Acting Provincial Agricultural Officer,
Coast Province.

ANNUAL REPORT OF THE SENIOR ENTOMOLOGIST FOR 1950

Plant Protection

New Legislation.—On receiving advice from the Commonwealth Mycological Institute that a hitherto unknown virus disease of sunflower had been found in South America it was decided to add sunflower to the scheduled list of seeds which require a plant importation permit before importation, whether in small quantities or not. This was done in Plant Protection (Import Control) (Amendment) Order, 1950 (Government Notice No. 277 of 6th March, 1950).

Other legislation under this Ordinance is mentioned under Maize Stalk Borer, Sisal Weevil and Banana Weevil.

Importation of Plants.—The work of the Plant Protection Ordinance continued to increase and a total of 972 plant importation permits were issued. Although the bulk of the plant material was imported through Mombasa and inspected by the Chief Grader and Inspector, importations through Nairobi considerably increased. Parcels imported by post and examined at the Scott Agricultural Laboratories totalled 1,433, this figure does not include plant material imported by air and inspected at Eastleigh and Nairobi West Airports.

One hundred and eleven consignments of plant material intercepted were found to be infested by insect pests or plant diseases, or were held owing to some infringements of the Plant Protection Ordinance. In a number of these cases after the material had been fumigated or specially treated it was possible to release it on receipt of the statutory fine. A few cases occurred where it was necessary to destroy the material immediately but in most cases where the material could not be passed for importation opportunity to re-export was given. The fines collected amounted to Sh. 928 which is a large increase over the previous year, mainly due to the importation of one or two bulk consignments consisting of a large number of individual packages and does not reflect a big increase in numbers of infringements of the Plant Protection Ordinance.

Export of Plants.—Since the introduction of the standard fumigation of mealy bug infested plants with HCN the amount of material exported has increased to almost three times that of the previous year. In 1950, 229 export certificates were issued.

Insects and plant diseases intercepted.—The following insects and diseases were among those intercepted on imported plant material at Nairobi. Most of these have not been fully identified.

<i>Pheidole</i> sp.	Cut flowers	South Africa
<i>Calandra oryzae</i>	Sorghum seed	Australia
<i>Oryzaephilus surinamensis</i>	Sorghum seed	Australia
<i>Laemophloeus</i> sp.	Sorghum seed	Australia
<i>Calandra oryzae</i>	Simsim seed	Mogadishu
<i>Oryzaephilus surinamensis</i>	Simsim seed	Mogadishu
<i>Laemophloeus</i> sp.	Simsim seed	Mogadishu
<i>Pseudococcus</i> sp.	Leucospermum, Protea and Seruria plants	South Africa
<i>Diaspine</i> scale		
<i>Lepidosaphes</i> sp.	Orchids	India
Ants		
<i>Diaspine</i> Scale Insects	Cinnamon seedlings	Zanzibar
Mites	Mango fruit	Zanzibar
Coccid sp.	Euphorbia	Eritrea
Coccid sp.	Lucerne seed	Argentina
<i>Pseudococcus</i> sp.	Cut flowers	Switzerland
<i>Dermestes</i> sp. larvae	Cut flowers	Ethiopia
Thrips	Grapes	Palestine
Thrips	Apples	South Africa
<i>Pseudococcus maritimus</i>		
Red Spider Mite		

Red Spider Mite	Citrus fruit	South Africa
<i>Chrysomphalus aonidum</i>	Oranges	South Africa
<i>Lepidosaphes pinnaeformis</i>	Oranges	South Africa
Mites	Chikoo fruit	India
Mites	Gooseberries	United Kingdom
<i>Pseudococcus</i> sp.	Citrus fruit	Palestine
Codling Moth	Apples	Italy
Coccid sp.	Citrus fruit	Mogadishu
<i>Aspidiotus</i> sp.	Oranges	India
Thrips	Cut flowers	South Africa
<i>Diplodia tubericola</i>	Sweet Potatoes	U.S.A.
Crown Gall	Peach trees	South Africa
<i>Plodia interpunctella</i>	Walnuts	Italy
<i>Ephestia</i> sp.	Walnuts	Italy

Fumigation.—During the year many more fumigations were needed and it was necessary to build another fumigation chamber to enable two fumigations to be carried out at the same time. The new chamber (capacity 100 c. ft.) was built also to economize in the use of fumigants and is proving very satisfactory for small consignments since it can be cleared more readily than the 500 c. ft. chamber.

The majority of fumigations were carried out on material for export to Tanganyika Territory chiefly to protect that territory from danger of introducing the common mealy bug *Pseudococcus kenyae* Le Pelley. To avoid transfer of this and other bugs about Kenya a number of fumigations were made on plant material to be moved from infested to uninfested areas within this country.

Experiments were carried out to determine the dosages of different fumigants against various insects to secure complete kills with the least harmful affect on the host plants.

Fumigations have also been carried out in connexion with the experiments in progress in stored grain. The chambers have also been used to fumigate the infested plant material imported from abroad as an alternative to destruction. This is only possible when fumigation can be considered a complete safeguard.

The fumigation chambers will be made available to farmers or others who are asked to give a few days notice when they wish to take advantage of this.

The fumigants in general use are HCN, Methyl bromide, CS₂, and on occasions ethylene dichloride/carbon tetrachloride and Azo-benzene smoke.

Acknowledgments.—As usual the closest co-operation was maintained with the Senior Plant Pathologist whose valued advice was fully sought and much appreciated. The work of the Chief Grader and Inspector in inspecting the importations through Mombasa was as usual a major factor in operating this Ordinance, and I wish to thank him for his co-operation with this section at all times.

Acknowledgments are due to the Customs and Postal Authorities for their help throughout the year. Mr. Walters of East African Airways Corporation is especially thanked for his helpfulness.

General Advisory Work

Three hundred and eighteen items of infested plant material or insect pests were received in the laboratory for examination or advice. A large number of visitors seeking advice on insect control visited the laboratory during the year. Also a large number of visits were made by representatives of commercial firms interested in insecticides, laboratory equipment and other subjects. Investigational and advisory visits were made to the Coast Province, Mombasa, Kwale and Kilifi districts; Central Province, North and South Nyeri, Karatina, Kiambu, Machakos; Rift Valley Province, Kitale, Eldoret, Endebess, Molo, Njoro, and Elmenteita.

Stored Products Work

This work continued throughout the year under the direction of an Inter-departmental Committee, the Pest Infestation of Stored Products Committee, consisting of the Senior Entomologist; the Controller, Maize and Produce Controls; and a Senior Medical Officer. There were eight meetings during the year. The following subjects were among those discussed:—

- Legislation on use of insecticides in foodstuffs.
- Experiments with insecticides in stored grain.
- Staff required for stored products pest infestation work.
- Fumigation of grain.
- Recommendations in the Oxley Report on grain storage in East and Central Africa.
- Wholesomeness and palatability of maize as influenced by pest infestation.
- Permissible dosages of pyrethrum and BHC insecticides.

During the year the committee decided on available evidence or rulings from the United Kingdom based on investigations of the Medical Research Council, to approve the use of pyrethrum in foodstuffs up to a maximum of 25 parts per million of pyrethrins, and the use of BHC in foodstuffs up to a maximum of one part per million added in the form of a diluted dust made from BHC containing 12 per cent or more of the gamma isomer. This latter is lower than the permissible limit in the United Kingdom but is generally considered not to be below the effective limit for practical control of Calandra, and allows a good safety margin.

The Committee having regard to the necessity for efficient prevention and control of food infestation recommended that provision should be made for technical staff to ensure that the necessary biological observations in laboratory and stores and experiments with control measures could be carried out. This was agreed on the basis of one entomologist and one stored products inspector for specialized pest infestation work. The stored products inspector was appointed in July but efforts to fill the post of entomologist were not successful. The inspector was mainly occupied with computation work in connexion with past experimentation, and with further insecticide experiments in progress during the year. His work has been most valuable on the entomological experimentation but has meant he has been unable to spend much time on general investigations of storage conditions, work which is also very urgently needed. The whole programme of essential work envisaged by the Committee cannot be tackled until an entomologist is appointed.

EXPERIMENTAL WORK

1. Experiment to test BHC, DDT, Pyrethrum in two dust diluents. A randomized block experiment with 60 full-sized maize bags.

Result.—The computations have now been completed and results should shortly be published. In the BHC/Diatomite treatment the numbers of Calandra were significantly lower than in all other treated bags. In the conditions of the experiment with the Pyrethrum/Bentonite treatment the numbers of Calandra were significantly higher than in nearly all other bags including controls.

2. Experiment to test the formerly permitted dosages of DDT, BHC, and pyrethrum and all combinations of these insecticides using two different diluents and two conditions of grain. A large randomized block experiment using a total of 320 full-sized maize bags.

Result.—The computations have now been completed and results should shortly be published. The most effective insecticide in the conditions of the experiment was BHC. Pyrethrum also had an appreciable effect in reducing the damage caused by insects.

3. Experiment to test the effect of impregnation of ordinary jute bags with pyrethrum and synergist substances.

Result.—No effect in the conditions of the experiment since treated and untreated bags became equally infested. It seems possible that insects were able to enter the bags near the seam without appreciable contact with the insecticide.

4. To determine whether treatment in the conditioning plant entirely eradicated all insect infestation. The plant was run in the normal manner and also at as high a temperature as could be obtained.

Result.—Insects eventually appeared in all samples of conditioned grain, thus proving that the conditioning does not completely free grain from insects. The treatment is nevertheless of great value in pest control since the rate of infestation is slowed down for a long time.

5. Experiment to determine the effect of pyrethrum, pyrethrum/diatomite (Pysil) and diatomite on slightly infested maize. A randomized block experiment with 48 maize bags.

Result.—Experiment is still in progress. Present indications are that the diatomite alone and the pysil provided more protection in the conditions than the other treatments.

6. Experiment with same substances as No. 5, on 24 maize bags.

Result.—Experiment still in progress. Indications show a similar tendency to that in 5 but less marked.

7. Experiment to test the effect of pyrethrum, pysil and diatomite at high humidity. Sixteen bags in room maintained at approximately 65° Relative Humidity.

Result.—Experiment still in progress, no results yet available.

8. To test the effect of pyrethrum and pyrethrum-piperonyl butoxide mixtures of United States origin, with pyrethrum piperonyl butoxide mixtures made up with a local filler. BHC included for comparison. Randomized block experiment with 40 bags. This experiment was planned during the year but was not set up until early in 1951.

Result.—No results at time of writing.

An apparatus was designed by Mr. Kockum during the year for the control of humidity in experimental rooms. This apparatus included some new features and it has been in use very successfully in experiment 7 above.

Mr. P. D. H. Megson then newly appointed to the post of Grader and Inspector spent about two weeks in the section to obtain a detailed knowledge of the operation of the Plant Protection Ordinance in Nairobi, and of the Stored Products work, especially the identification of storage pests.

FUTURE PLANS

The following work is among that to be undertaken when time and staff permits. Survey of African storage conditions and losses in African stores. Study of temperatures, moisture contents and insect infestation in large block stacks. Experiments with insecticides at dosages not related to any permissible limits but designed to determine effective dosage ranges. Bionomics in local conditions of the chief storage pests. Thermal death points of all stages of local storage insects for general information and particularly to determine heat conditioning temperature effective for disinfecting grain. Survey of European storage conditions, losses and control measures.

General Investigations

Maize Stalk Borer (Busseola fusca).—The prohibition of planting of maize approximately from June till February in order to secure a maize-free period between harvesting and the next planting was once again gazetted. Its observance by all farmers is most important if infestations of this insect are to be kept

within bounds. It is necessary to maintain this every year as the first of the valuable control measures against this insect. The second measure is the use of insecticides and both DDT 1 per cent in diatomite, and Derrisol 1 in 600 have their advocates, both are effective. The Senior Entomologist visited a number of districts in the Central Province in August to examine the position. Stalk borer was not severe in the Kitale and Eldoret areas (although it was reported to have been bad early in the year) this was no doubt due to the widespread use of insecticides. A fairly heavy attack of stalk borer developed in the Nakuru area, estimated at 25 per cent of the stalks bored, and the imposition of a burning order was considered, though finally it was decided that this would not be enforced in 1950. DDT 1 per cent at about 10 lb. mixed dust per acre has continued to prove a very effective treatment.

Black Wheat Beetle (*Heteronychus* sp.).—Very severe damage was done to seedling wheat, barley and other cereals in the Ol Kalou, Ol Joro Orok areas by a number of beetles the most injurious of which is the Dynastid *Heteronychus consimilis*. This amounted in cases to complete destruction entailing one and even two replantings. Local experiments by the Agricultural Officer with BHC baits showed promise. It was decided that a special study of the beetles concerned should be made in 1951 with experiments for their control.

Termite Control.—For many years past this Section has experimented with methods for the control of termites, particularly the common termite of the Nairobi area *Odontotermes badius*. Experimentation during the year consisted of trials of the application of toxic BHC smoke using the "Gammexane" smoke generator No. 12 and applying it with a pressure applicator. This method was developed by Mr. W. G. Coaton of the Division of Entomology, South Africa. The pressure applicator used in all the early trials was one locally made which proved very satisfactory. Later a commercial South African model, also satisfactory, was tried. The method proved the most effective of any yet tried and complete destruction of 17 out of 22 treated nests was obtained. A description of the method was prepared but not published until February, 1951.

Jacaranda bug. *Orthezia insignis*, (Coccidae).—This objectionable insect which disfigures Jacaranda trees and many garden plants was as usual in evidence in Nairobi gardens during the year. It has now spread beyond Fort Hall and has appeared on Lantana in the Teita Hills area where it must have been accidentally introduced. Experiments with contact sprays for its control have been continued and some of the newer sprays appeared at the year's end to show promise. The ladybird beetle introduced some years ago by the Forest Department is still to be found in the field, but has not so far proved to be a predator of major importance. A stock of this predator was taken over at the end of the year at the request of the Forest Entomologist that we assist in its multiplication.

Injurious Grasshoppers.—In July there was an increase in population of several species of indigenous grasshoppers to a level which caused severe damage to grazing in the Elmenteita area. The species responsible for the bulk of the damage were *Gastrimargus brevipes* Sjost. and *Caloptenopsis meruensis* Sjost. The infestation had almost completely stripped the grass. It was treated with a bran and agroicide bait. It is considered that the distribution of rain in the early months of the year, with appreciable falls followed several times by dry spells may have been a factor contributing to the unusual increase. A short note on this occurrence was prepared for publication.

Injurious Ladybirds.—The Coccinellid *Epilachna hirta* Thunb. is a well-known pest from time to time attacking maize, other cereals, potatoes and some other crops, appearing in large numbers and causing a good deal of damage. In May and June of this year there was an unusually heavy attack on grass by several species of leaf-eating Coleoptera especially *Epilachna hirta* over a wide area of the Rift Valley and especially severe on one farm at Elmenteita. The attack had caused the grass to brown off and the growth was so much reduced

as to prevent haymaking which would otherwise have been possible. It cannot be controlled by baits and there is no practical control measure which would prove economic over the huge areas infested. It is fortunate that such an attack is rare, and it may have been induced by the distribution of rain mentioned above.

Fruit Flies.—Flies of the family Trypetidae continued to do damage to fruits throughout the year. Records of *Pterandrus rosa* and *Ceratitis capitata* on peaches were common. *Dacus* sp. on fruits of Loofah (*Luffa cylindrica*) at the Coast and *Dacus* spp. on cucumbers and marrows were present in many districts. The attack on loofah is a serious threat to the development of this production. This fruit fly should succumb to some of the standard baits, such as BHC or Nicotine as mentioned in last year's report, but growers reported lack of success with these baits, due it is thought to too late application. Mr. James McGough was present for a short while early in the year in continuation of his work for the biological control of *Dacus ferrugineus dorsalis* Hendal in the Hawaiian Islands.

Pests of Garden Plants.—There are a number of pernicious insects which constantly trouble the gardener in this country and a good many requests for advice on their control are received. Among these may be mentioned the Common Mealy bug *Pseudococcus kenyae*. The severity of this insect on garden plants has declined since the introduction of parasites but occasionally it increases in gardens, and parasites have been released. Modern systemic insecticides are probably the answer if this bug becomes severe in gardens. The Jacaranda Bug *Orthezia insignis* is a much worse pest and is a real menace to the garden lover. Successful biological control of this insect has not been achieved, but systemic insecticides have proved promising and may be developed against it. *Icerya purchasi* is another bad pest of roses and other garden plants but is not so difficult to control by standard nicotine and other sprays. Gladiolus Fly *Epiniadyza nigra* is a common pest and is controllable by DDT sprays.

Dusty Ground Beetle. *Dasus simplex* (Tenebrionidae).—This insect is one that does appreciable damage to a number of plants every year and in 1950 was more than usually injurious especially to seedling maize. It is controlled by poison baits and success has been obtained in experiments with BHC at a strength of 0.07 per cent gamma BHC in the dry bait material. This is effective in the field if applied in time, though the insect is not very conspicuous and damage is often severe before it is noticed.

Chafer Grub. *Schizonycha* sp. (Melolonthidae).—This pest was not especially severe during the year though it always does some damage in the Trans Nzoia. Plans were made to introduce Scoliid parasites from Mauritius with a view to establishing them against the Chafer and it is hoped that it will be possible to operate these plans in 1951.

Wattle and Maize Weevil. *Nematocerus* sp. (Curculionidae).—A new pest of Wattle was recorded in 1949 which proved to be an undescribed species of *Nematocerus*. An effective control by baiting with green maize and BHC was developed by Mr. J. F. Graham, an account of which was published in the K.I.O. Fortnightly. In 1950 another very severe attack both on young seedling wattle and young seedling maize developed at Eldoret, Sergoit and Moiben in April at a time when there was no bulk of green maize present to use as bait. A fairly satisfactory substitute bait was composed of couch grass (*Digitaria abyssinica*) molasses and BHC. This was not so attractive as the maize but control was secured by a number of applications, each application being found to cost about Sh. 1/70 per acre. More succulent grass such as Kikuyu grass proved more attractive in the laboratory and should be used when possible in place of couch. An estimate of the numbers of the weevils present in young maize based on a number of sample counts gave 100,000 beetles to the acre. This attack was controlled by the farmer concerned with a bait of maize flour and BHC. The severe attack this year followed a break in the rains which

resulted in germinated seedlings having to hold on for more rain. These conditions favour severe insect damage, and were common in many districts resulting in unusual damage from a number of pests.

Cassava Scale. Aonidimytilus albus (Coccidae).—This scale was reported in November from the Alego location in Central Nyanza. Since then it has spread to three other locations and is causing grave concern since Cassava is an important food and cash crop there. A good kerosene emulsion has been recommended since this can be made from materials readily obtainable in African areas, and does not have the toxic hazard of newer insecticides.

Rhinoceros Beetle of Coconut. Oryctes monoceros (Dynastidae).—It had been clear for some time that infestation by this beetle on coconuts at the Coast was severe and an opportunity occurred in January to tour a part of the Coast Province to investigate the incidence of this pest. It was found on this tour to be a major pest in the whole area visited from Gazi through Mombasa as far as Kilifi. It was causing appreciable loss of trees and substantial reduction of crop in trees attacked but not yet killed. Conditions were very favourable to a heavy attack with bush, high grass and weeds commonly present and dead and dying trees both standing and fallen very numerous, and these breeding large numbers of beetles. It was clear that for the position to improve it would be necessary to have a "clean-up" and that powers to enforce this would be necessary. The Coconut Preservation Ordinance, Ordinance No. 21 of 1915 contained the powers necessary, but it had not been brought into force. It was decided immediately to make the Ordinance operative in "the administrative districts of Lamu, Tana River, Kilifi (including Malindi sub-district) Mombasa and Kwale," and this was done in Government Notice 499 dated the 24th day of April, 1950. The enforcement of the clean-up will take time and will depend largely on the enthusiasm of the agricultural staff, but by the year's end considerable progress had been made particularly in the coastal strip south of Mombasa where dead and dying trees were already scarce and a great clean-up had already been achieved. It is hoped to experiment with traps for this beetle (an old method practised at the Coast in 1917-18) but this work has been delayed by shortage of staff.

Pineapple Pests. Pseudococcus brevipes (Coccidae).—The Mealy Bug *P. brevipes* was reported as spreading in one coast plantation, and control measures in use were spraying with a proprietary DDT emulsion and treating the ground with BHC, against ants, the results not being reported. It is clear that work on the control of this insect is required.

Diaspis bromeliae. (Coccidae).—This was still present and widespread in one estate in the Thika district, and success in controlling it has not been obtained with any sprays yet tried. Some of the modern systemic insecticides might prove effective, though the toxic hazard would have to be carefully considered.

False Codling Moth. Argyroplote leucotreta (Tortricidae).—This insect is common and injurious, and the list of its host fruits is being extended, notably this year it has been bred from tea seed and castor seed. It continues to do much damage to citrus and peach. No control is known other than picking and removing all attacked fruits from tree and ground.

Tomato "Worm". Heliothis obsoleta (Noctuidae).—This injurious Noctuid was once again in evidence during the year, two severe attacks by its larvae being seen, one on sunflower at Turbo, and one on tomato at Thika. The sunflower was reported to be so heavily attacked as to cause a very great reduction in the crop. The attack on tomato was visited and counts showed over 75 per cent of the fruits to have been eaten into by larvae.

Sweet Potato Weevils. Alcidodes clathratus (Curculionidae), *Alcidodes dentipes* (Curculionidae), *Cylas puncticollis* (Curculionidae).—Damage was reported by these weevils in the Kiambu and Kabete areas late in the year. Investigation showed that *Cylas* was common and very injurious, but the

Alcidodes (less well-known and being new records for Kenya) were also doing severe damage. Arrangements were made at the year's end to begin a study of these weevils.

Sisal Weevil, Scypophorus acupunctatus (Curculionidae).—This insect introduced from Tanganyika, is known to be present in injurious numbers at Mwatate, but it has also spread to the Kilifi area doubtless through infested planting material. There was a very heavy attack on one sisal plantation at Kilifi between 1946 and 1949 and the most strenuous efforts were made to control it both by collecting beetles and by careful estate sanitation particularly cutting down, splitting and drying the old poled plants. On a visit in 1950 weevils could not be found and though it is not suggested that it was eradicated there, nevertheless the careful trapping and good estate sanitation were considered undoubtedly responsible for a complete economic control in the conditions. It is encouraging to think that careful sanitation may prove to be of such value.

As the Sisal Weevil is a fairly recent introduction and is so far confined to areas in the Coast Province it was decided to schedule it as a pest and this was done in Government Notice No. 330 dated 15th March, 1950, and to declare the Coast Province to be an infected area, prohibiting the movement of any species of Agave or Furcraea from the Coast Province without permission of the Director of Agriculture. This was done in Government Notice No. 331 dated 1st March, 1950.

Banana Weevil Cosmopolites sordidus (Curculionidae).—This insect was found in Kenya for the first time in the latter half of 1949 in the Marama location of North Nyanza. Early in 1950 it was found to be present also at Kwale in the Coast Province, and later proved to be widespread in the Kwale district indicating that it must have been present for a long time. The Central Province still appears to be free. The insect was gazetted as a pest in Government Notice No. 330 dated 15th March, 1950. The control measures are largely based on the maintenance of a high standard of plantation hygiene. How far this will be obtainable in the areas infested remains to be seen.

Fruit Sucking Moths.—For some time it has been evident that damage occurs to fruit which cannot be ascribed either to False Codling Moth or fruit flies. The fruit shows damage identical with that described for fruit sucking moths. This was particularly severe on pears early in the year in one orchard in Molo. Traps were used but no moths which could be considered a cause of the trouble were taken. The whole matter requires study, including detailed experimentation with traps. Several genera of moths known to suck fruit elsewhere are well represented in this country so it is almost certain that an important problem exists which has hitherto been neglected.

Miscellaneous Pests

The following pests were recorded during the year:—

- Pseudococcus brevipes* on pineapple at Fort Hall.
- Aonidiella aurantii* on citrus spp. at Nairobi, Nyeri and Gilgil.
- Pseudococcus kenyae* on Mango and Guava at Nairobi.
- Icerya purchasi* on citrus spp. at Nairobi and Thomson's Falls, roses at Rongai, wattle at Soy, pigeon pea at Voi.
- Orthezia insignis* on Jacaranda at Nairobi, garden plants at Nanyuki, Lantana at Voi.
- Aspidiotus camelliae* on rose at Eldoret.
- Chionaspis graminis* on *Panicum coloratum* at Machakos.
- Aulacaspis cinnamomi* on Mango at Nairobi.
- Tachardia* sp. on *Annona* sp. (Custard Apple) at Eldoret.
- Eriosoma lanigerum* on apple at Molo, Kinankop.
- Brevicoryne brassicae* on Brassica spp. at Nairobi.
- Cerataphis* sp. on rose at Mombasa.
- Trioza merwei* on citrus at Nairobi.

Argyroplote leucotreta on citrus at Kabete and Kakamega, tea seed at Teita, castor seed at Mombasa, peach at Nairobi.
Etiella zincinella on *Tephrosia vogelii* at Kericho.
Colias electo on lucerne at Limuru.
Busseola fusca on maize at Karatina, Sotik, Nakuru, Eldoret, etc.
Laphygma exempta on grass, sorghum and maize at Nairobi and Makueni.
Heliothis armigera on sunflower at Turbo, tomato at Thika.
Plutella maculipennis on Brassica spp. at Nairobi, Molo and Kiambu.
Cosmopolites sordidus on banana at Kwale and North Nyanza.
Heteronychus consimilis on wheat at Ol Joro Orok.
H. tenuestriatus on wheat and sunflower at Lumbwa.
H. sp. indet. on maize at Naivasha.
Nematocerus sp. on wattle and maize at Eldoret.
Megalognatha sp. on wattle at Eldoret, maize at Kakamega.
Epicauta sp. on potato at Nakuru
Gonipterus scutellatus on Eucalyptus sp. at Elburgon and Kinankop.
Dasus simplex on cereals at Gilgil and Timboroa, garden plants Timau, passion fruit Lumbwa and Kericho, maize at Naivasha, tea Kericho, sisal Taveta, etc.
Epilachna hirta on *Cynodon plectostachyum* (star grass) at Elmenteita, *Solanum muricatum* at Lumbwa, maize at Kitale.
Aspidomorpha spp. on Sweet Potato at Kabete.
Cylas puncticollis on Sweet Potato at Kabete.
Alcidodes orientalis on Sweet Potato at Kiambu.
Halitica sp. on rhubarb at Turi.
Lagria villosa on soya bean at Kitale.
Epimadyza nigra on gladiolus at Nairobi and Limuru.
Cecidomyid on seed of *Brachiaria brizantha* at Kitale and Nairobi.
Dacus sp. on fruits of *Luffa cylindrica* (Loofah) at Mombasa and Gazi.
Gastrimargus sp. and *Caloptenopsis sp.* on *Cynodon plectostachyum*, Elmenteita.
Thrips tabaci on onion at Timau.

Bee-keeping

Bee-keeping by Africans is, of course, common in most districts of the country. A certain amount of interest in bee-keeping by Europeans continues to be shown. There are of course several established European apiaries, though it is generally conceded that there are difficulties (doubtless not insurmountable) in the way of commercial bee-keeping in this country, one of which is the well-known fierceness of most African bees. On the other hand this country is believed to be free from European foul brood, American foul brood and Acarine infestation. In view of this and the fact that examination of living adult bees cannot disclose the presence of acarine infestation and some other diseases, it has been decided not to permit, for the present, the importation of queen and worker bees from Europe, America and other countries, South Africa only excepted. If at a later date adequate certification can be obtained and experience in the United Kingdom indicates that this is advisable the ban may be lifted, but its careful implementation is undoubtedly in the best interests of all bee-keepers, of whatever race in this Colony.

The importation of bees is controlled under the Diseases of Animals Ordinance the relevant Government Notice being as follows:

"GOVERNMENT NOTICE 304 OF 17TH JUNE, 1938, (DISEASES OF ANIMALS ORDINANCE)

(4) Bees shall not be imported into the Colony unless before importation the Director of Agriculture has granted a permit in respect of such importation. When such a permit has been granted the bees shall be consigned to the Director of Agriculture in the first instance unless he grants exemption."

The Tachinid *Rhodanioestrus apivorus* well-known in South Africa was identified during the year from specimens taken in an apiary of the Kinankop. This insect takes a small toll of worker bees by laying on them usually when returning to the hive. From time to time Chelifers from beehives are sent in for identification and several lots were received during 1950. So far these arachnids, which appear to be common, have not been identified to species.

Biological Control

Short notes are given on the present position of projects past or in operation:—

(1) *Common Mealy Bug (Pseudococcus kenyae)*.—Control by introduced parasites. The introduction, rearing and liberation now comes wholly under the Coffee Research Station. The great value of the parasites may well be mentioned here, since the very complete control of mealy bug achieved in the African areas of the Central Province tends to results in its being forgotten. The position may perhaps best be indicated by a comparison. In the South Tetu areas of the Nyeri district in 1939 great areas were present where bush and crops were black, extremely severe damage was then occurring to pigeon pea, beans, yams and many other food crops. Yams in many areas had for this reason gone out of cultivation. In these areas, visited in 1950 a whole day's search failed to discover one mealy bug. Yams were flourishing at one place where acres of black crops and bush were present in 1940 when the liberations were made. The mealy bug is still present in all the African lands but it has ceased to be a major pest, and is usually a rarity. The establishment of this biological control has made a real difference to the prosperity of thousands of African farmers.

(2) *Woolly Aphis of Apple (Eriosoma lanigerum)*.—Control by introduced parasite. The parasite *Aphelinus mali* is present in very large numbers on the Kinankop where it is undoubtedly exercising a great measure of control. It is doubtful if apple growing would be possible there without it, certainly not without great expenditure on spraying.

The Woolly Aphis was reported on one or two farms in the Molo area and through the co-operation of the Agricultural Officer (Hort) parasites obtained from the Kinankop were introduced there in June.

(3) *Eucalyptus Weevil (Goniapterus scutellatus)*.—Control by introduced egg parasite. The parasite *Anaphoidea nitens* is present fairly generally. In some areas it is little in evidence but in most parts it is common and undoubtedly exercises a very great controlling influence on the pest.

(4) *Jacaranda Bug (Orthezia insignis)*.—Control by introduced Coccinellid. The Coccinellid (Ladybird) Beetle *Hyperaspis jocosa* introduced some years ago by the Forest Department has hung on and can still be found in the field. Up to the present it has not been an important controlling influence. Mass breeding and large-scale liberations have not yet been made and should be tried.

FUTURE PROJECTS

(1) The introduction of Scoliid parasites of Chafer Grub for the control of the Chafer Grub *Schizonycha* sp. of the Trans Nzoia. It is hoped to arrange for the introduction of Scoliids from Mauritius in 1951.

(2) It is hoped to be able to arrange in 1951 for the introduction of further controlling factors for the Jacaranda Bug.

(3) Importations of beneficial insects for the control of other pests await increase of specialist staff.

SENDING OF LOCAL BENEFICIAL INSECTS FROM KENYA FOR CONTROL OF OVERSEAS PESTS

(1) Early in the year some airmail shipments of parasitized scale insects (*Saissetia oleae*) and (*Saissetia* sp.) were made to the Division of Beneficial Insects, University of California.

(2) Mr. James McGough continued in the early months of the year, his collection and dispatch of fruit fly parasites for the control of the Oriental Fruit Fly in the Hawaiian Islands.

Insects Aattacking *Heliotropium* Spp.

Early in the year we were asked by the Commonwealth Institute of Entomology to give information on the distribution in this country of species of the plant genus *Heliotropium*, and any available information on the insects attacking plants of this genus. This was required in connexion with an attempt that was likely to be made to control *Heliotropium europaeum* in Australia where it had become a serious weed. There was no information in this latter respect but opportunity occurred to investigate some species of the genus in the field and collect the insects attacking them. Over 50 insect species were obtained some of which were of considerable interest. A species of Tingid was common on one species of *Heliotropium* and caused browning and drying of foliage. This is a species of *Monanthia* not in the British Museum. Species of Cecidomyid was common in galls on the flowering spike, it is probably of an undescribed species and may warrant a new genus. A species of the Curculionid genus *Alcidodes* was bred from stem galls on another species of *Heliotropium*.

List of Insects Identified During 1950 Being New Records

APHIDIDAE

Aulacorthum solani Kltb. on potatoes in store, Kinankop.

DYNASTIDAE

Heteronychus tenuistriatus Fairm. on wheat, Lumbwa.

Heteronychus consimilis Klb. on wheat, Ol Kalou.

CURCULIONIDAE

Oreorrhinus abedariensis Mshl. peas, Mau Summit.

O. glabricollis Mshl. Nandi.

Opseodes piger Mshl. Cotton, cassava, Kilifi.

Sphrigodes subdenudatus Hust. Vegetables, Fort Hall, Kerugoya.

Entypotrachelus micans Hust. *Heliotropium*, Naivasha.

Aperitmetus brunneus Hust. Beans, cabbage, Kerugoya.

Nematocerus productus Mshl. Langata.

N. striolatus Auriv. Peas. Rumuruti.

Neoclanus sannio Hbst. Mustard, Nairobi.

Lexus germaini Hust. Mustard. Nairobi.

Endaeus sublucidus Mshl. *Thespesia danis*, Vitengeni.

Apion considerandum Fhs. Kilifi.

A. kwaiense Htm. Hibiscus calycinus, Nairobi.

Apion solarii Wagn. Hibiscus micranthus, Kibarani.

Acallopietus maculithorax Hust. Abutilon, Bukura.

Alcidodes clathratus Bert. Sweet potato, Kiambu.

Alcidodes dentipes Oliv. Sweet potato, Kiambu.

LAGRIIDAE

Chrysolagria apicata Har. Kabete.

CERAMBYCIDAE

Hesperophanes fasciatus Billb.

LAMIIDAE

Nupserha apicata latevittata Brng. Thika.

Crossotus plumicornis Serv.

Niphona appendiculata Gerst.

TACHINIDAE

Rhodanioestrus apivorus Villen. Parasitizing honeybee, Kinankop.

ACRIDIDAE

Truxalis burtii Dirsh. Swamp near Kibwezi.

Truxalis annulata Thunb. Swamp near Kibwezi.

LASIOCAMPIDAE

Leipoxais compsotes Tams. Nairobi.

Gonometa diucei B.Bak. Wattle, Kikuyu.

DREPANIDAE

Lomadontophana subtilis. Nairobi.

LYMANTRIIDAE

Euproctis fasciata Walk. Wattle, Eldoret, Kitale.

Dasychira extorta Dist. Nairobi, Kabete.

ARCTIIDAE

Spilosoma euryphlebia Hmp. Moyale.

AMATIDAE

Metarcia rubripuncta Hmp. Ficus sp. Nairobi.

METARBELIDAE

Marshalliana bivittata Aur. Kabete.

Metarbelodes obliqualinea B.Bak. Nairobi.

PYRALIDAE

Thilodes productalis Hmp. Thunbergia, Nairobi, Limuru.

Boryodes hirsutalis Walk. Nairobi.

Mecyna gilvata F. Lupin, Kitale.

Nomophila noctuella Schiff. Kabete.

TORTRICIDAE

Argyroploce peltastica Meyr. Pigeon Pea, Kilifi.

GEOMETRIDAE

Rhodometra sacraria L. Grass, Nairobi.

Epigynopteryx flavedinaria Guen. Kabete.

Omphax plantaria Guen. Nairobi.

NOCTUIDAE

Agrotis ypsilon Rott. Maize, Taveta.

Elaeodes prasinodes Prout. Bracken, Limuru.

Achaea indeterminata Walk. Calpurnea, Kitale.

Othreis materna L. Peaches, Ulu.

Othreis fullonica L. Peaches, Ulu.

Anua tirhaca Cr. Ulu.

Thyatirina achatina Weym. Cotton, Kibarani.

Polia consanguis Guen. Moyale.

Polia dipterigidia Hmp. Cotton, Nairobi.

Polia fuscirufa Hmp. Flax, Njoro.

Abrostola brevipennis Walk. Nairobi.

Eublemma snelleni Wallgr. Kabete.

Eublemma scitula. Kakusi.

Bareia incidens Walk. Nairobi.

Amyna punctum F. Nairobi.

Ophiuche masuralis Guen. Nairobi.

Nabartha pachycera Hmp. Nairobi, Ngong.

Acknowledgments

I should like to acknowledge the good work of European and African members of this Section.

I am most grateful for the help of many members of the Field Staff of this Department, particularly during my visits to their districts.

Once again it is a pleasure to record the help with advice and identification of insects received from the Commonwealth Institute of Entomology, help which is invaluable to the Section and essential to its work. Grateful acknowledgments are given to Mr. E. Pinhey of the Coryndon Memorial Museum for the identification of a large collection of Lepidoptera.

R. LE PELLEY,
Senior Entomologist.

ANNUAL REPORT OF THE SENIOR PLANT PATHOLOGIST, 1950

Investigational and Advisory

Cotton, coffee and forestry diseases are dealt with by their respective specialist teams and are not, therefore, included in this report.

Of the plant material examined in the laboratory, 399 specimens were received from the public and officers of the department.

Potato.—Blight, *Phytophthora infestans*, though widespread, was not so severe as in the previous year. As the disease is now fairly well known, fewer specimens were sent in for identification than previously.

From two native reserves in the Central Province were received specimens of the Bacterial Wilt, *Pseudomonas solanacearum* of the non-pigmenting strain previously reported. Eelworm, *Heterodera marioni* occurred on tubers from the same reserves and Dry Rot, *Fusarium moniliforme*.

Cereals.—“Take All” is still the most serious disease of wheat in the main wheat-growing areas. It is likely to continue so as long as wheat is grown in monoculture.

Puccinia glumarum was occasionally severe at the higher altitudes on both wheat and barley. Other diseases sent in for identification included, loose smuts of wheat and barley and covered smut of barley, *Septoria nodorum* and *S. tritici* on wheat, *Fusarium graminearum*, *Alternaria tenuis* and *Rhizopus nigricans* on ears of wheat. A number of maize diseases was received from the Trans Nzoia and Uasin Gishu. These were mainly cob rots and the previously recorded supposed bacterial disease of immature cobs and tassels, *Nigrospora oryzae* was the cause of a dry rot of the cobs.

Pyrethrum.—A total of fifty specimens of pyrethrum diseases was received. These were, in the main, connected with the “Bud Disease”, *Ramularia bellunensis*, which is still widespread but of less intensity than in the previous year. A high proportion of infected flowers was found in samples submitted for examination on account of low pyrethrin content.

Spraying trials against Bud Disease have been carried out at the Scott Agricultural Laboratories and at pyrethrum experimental stations in cooperation with the Senior Agricultural Officer (Pyrethrum) and his staff. In view of the fact that no data could be found to support the commonly held view that a copper spray interfered with the formation or the assay of pyrethrins, a preliminary trial was done with Perenox. The Scientific Adviser to the Pyrethrum Board assayed the pyrethrin content of sprayed and control flowers and contrary to expectation, found that the spray neither lowered the pyrethrin content nor interfered with the assay. As a result, larger scale trials are now in progress, spraying at monthly intervals, with Perenox and Perenox plus Albolineum. The latter mixture showed better spreading and adhesive qualities. A long range trial with Perenox and Tulisan on a field scale is in progress at a high altitude farm. Smaller preliminary trials have been started with certain American proprietary organic fungicides, viz., Dithane, Zerlate, Fermatè and Parzate. Other diseases received included *Fusarium* spp., *Sclerotinia sclerotiorum* and *S. minor* from root, and crown rots and *Coniothyrium* sp. *Microdiplodia* sp. and *Botrytis cinerea* on buds and flowers.

Grasses and Legumes.—Diseases of herbage from pasture research stations included *Fusarium graminearum* on heads of *Pennisetum glabrum*, of which about 25 per cent of the total number of florets were infected. *Brachiaria brizantha* was infected with *Sphacelia* sp., *Cynodon dactylon* by *Ustilago cynodontis*, *Pennisetum polystachyon* by *Beniowskia sphaeroidea*, *Dactylis glomerata* by *Puccinia graminis* forma and *Digitaria* sp., by *Phyllachora digitariae*.

Two Nairobi golf clubs simultaneously reported that their recently established greens were going off in patches. The grass, a *Cynodon* species, was found to be attacked by *Helminthosporium cynodontis*. Over watering was a probable pre-disposing factor. Treatment with a proprietary mercurial lawn dressing was suggested and proved effective.

Lucerne was attacked by *Peronospora trifoliorum*, rust, *Uromyces striatus* and leaf spots *Pseudopeziza medicaginis* and *Sphaerulina trifolii*. As in other years, peas were generally attacked by *Ascochyta pisi* and *Erysiphe polygoni*. *Fusarium* sp. was isolated from wilted *Crotalaria juncea*. *Trifolium johnstonii* in pasture experimental plots was seriously affected by a systemic aecidial rust.

"Pasma" disease of flax, *Sphaerella linorum* and *Phoma linicola* caused loss of crop at 9,000 feet. Severe attacks of *Cystopus tragopogonis* and *Puccinia helianthi* occurred on sunflowers in most localities where grown. *Cystopus candidus* severely affected a crop of Indian colza. *Tephrosia candida* cover crop was defoliated by *Cylindrosporium tephrosiae*. No new pathogens were received on passion fruit but *Septoria fructigena*, *Alternaria passiflorae* and *Fusarium* root rot occurred in the chief commercial passion fruit districts. "Woodiness" is still prevalent. *Phyllosticta theae* was received on tea. Minute nodules on the roots of tea seedlings, sent in as possibly eelworm, were found to contain a yeast-like fungus.

Vegetables.—"Black Rot" of cabbages, *Xanthomonas campestris* was recorded for the first time and cauliflowers were attacked by an unidentified bacterial leaf-spot. *Septoria apii*—*graveolentis* was common on celery. Commercially grown chicory suffered from a tip blight caused by *Botrytis cinerea* and a tap root canker associated with *Alternaria tenuis*. The high surface soil temperature, in contact with the upper part of the tap root is considered to be a contributory factor. Other vegetable diseases included *Pseudoperonospora cubensis* on cucumber and a soft rot of parsley crowns ? *Bacterium carotovorum*.

Tomato blight, *Phytophthora infestans*, caused widespread destruction in commercial and private undertakings. *Alternaria solani* was also severe in one instance causing a canker of seedlings at soil level. *Cladosporium fulvum* caused damage for the first time in a commercial crop. Other diseases included eelworm, Blossom End Rot, *Septoria lycopersici*, and an unidentified rot of the green fruit.

No outstanding or new diseases were received on fruit and ornamentals with the exception of the sclerotial form of *Septoria gladioli* on Gladiolus corms and *Armillaria mellea* on bananas.

A disease of pineapples resembling "Brown Speck" of Queensland and from which *Penicillium* sp. and *Fusarium scirpi* were isolated, was received from two widely separated localities.

Wheat Stem Rust, *Puccinia graminis tritici*.—Forty collections of rust were received at the laboratory for determination of the physiologic forms. Eight of these proved to be the Kenya form 9, which appeared for the first time in 1949. Seven were apparently infected with a more virulent form of K.1 which has made its appearance again after a period of quiescence. The remainder of the rusts tested appeared to be mixtures of K.1 and the new form K.9. The segregation, multiplication and further testing of these rusts was not completed by the end of the year.

During the year, the physiologic forms have been maintained in culture. In view of the increasing difficulty of continuous culture under present climatic conditions, experiments are now being undertaken on the storing of the rusts in the laboratory and reinoculating at fairly long intervals. So far, collections have been kept for four months without loss of vitality.

The recent appearance of forms K.8 and K.9 has necessitated retesting a number of new hybrid wheats which had hitherto proved to be immune or resistant to the previously occurring rust forms. Twenty hybrids were tested with K.9, to which five were resistant and thirty with K.8, to which fifteen were resistant. Four hybrids were tested with all the forms from 1 to 9, with the exception of forms 3 and 5 which have been lost and have not since reappeared in field outbreaks.

The apparent breakdown of resistance of the established varieties to K.1 suggests an increase in virulence or a new form close to K.1 and emphasizes the impermanence of the rust position. There is now evidence of the emergence of yet another form, K.10, which is being investigated.

Erysiphe graminis severely attacked the glasshouse wheats and interfered considerably with the rust development. Red Spider and aphids have been successfully suppressed with an H.E.T.P. insecticide.

The usual artificial field epidemic for the trial plots was established at the Scott Agricultural Laboratories and material supplied for a similar epidemic at the Plant Breeding Station, Njoro.

Blight Resistant Potatoes.—Blight resistant potatoes, which have been supplied by Dr. W. Black since 1943, were multiplied during 1949 and part of the crop planted during 1950 at the Scott Agricultural Laboratories and on a farm at 8,500 feet where blight is usually much in evidence and where it was supposed aphids were rare. Sprouted seed potatoes in a store were, however, heavily infested with aphid, *Aulacorthum solani* (det. Dr. W. J. Hall through the courtesy of Dr. le Pelley) which may also occur in the field.

The following varieties were planted: 914 a 12, 1427 a 8, 1509 a 4, 1510 a 1, 1512 c 14, 1512 d 4.

The above had, hitherto, shown immunity from blight but with the exception of 1512 d 4, which is immune from biotypes A, B, C, E and F. All were attacked. It seems that those immune from A, B, E and F were attacked by biotype C and the A, C immunes were attacked by the new biotype E, which was first reported from Tanganyika. The result could not be confirmed at the Scott Agricultural Laboratories as no blight appeared. At the moment, it appears that 1512 d 4 is the only potato immune from all the biotypes now in Kenya. 914 a 12 (Craigs van Riebeck) proved to be the heaviest cropper in spite of the blight.

During the year, *Phytophthora infestans* was found on the foliage of woody perennial *Solanum* species from 6,000 feet in widely separated localities. The species so far found to be attacked, *S. indicum*, *S. panduriforme* and *S. incanum*, abound as weeds of waste places and grass lands and as forest undershrubs. None has previously been seen to be affected. The fungus from *S. incanum* readily infected potato foliage and tuber slice and from potato was transferred to *S. indicum*. Cultures of the fungus sent to Dr. W. Black were identified as strain C.

The presence of these perennial hosts growing over immense areas and at a considerable range of altitude present a permanent source of infection to the potato crop and may offer scope for the evolution of yet more aggressive strains of the fungus.

A bag of 1427 a 8 was treated with a sprout inhibitor when dormancy was breaking. The potatoes were kept in a shed with an iron roof, in which the daily temperature rose to over 90°F., i.e. under very adverse conditions. Nine months later the tubers carried sturdy apical sprouts not more than ½-inch in length and suitable for planting. By this means, it is possible to keep seed potatoes from one long rains season to the next without recourse to keeping the tubers exposed to light.

Seed Testing Laboratory

During the year, 590 samples of seed were received for analytical purity and germination tests. Samples tested were cereals, 176, peas 82, vegetables 74, miscellaneous crops 115, grasses 87 and some flower and tree seeds.

Tests on chicory seed, imported for commercial growing, were done, at the request of the importing firm, to ascertain the effect of length of storage and storage temperature on germination. Viability was unaffected after a period of 14 days at 60°C. At 80°C. for the same period, the germination figure was reduced by half and at 100°C. the seed was killed. Storage at 10°C. and 0°C. for periods of up to 8 weeks made little difference but the germination figure was slightly lower than for seed stored at room temperature. Monthly tests at room temperature carried out over a period of 12 months showed no deterioration.

Tests on the germination of coffee seed for the Coffee Research Station showed that seed at 30°C. had a slightly higher germination than those germinated at room temperature (19°C.—22°C.).

Tests on seed of *Brachiaria brizantha* and *Panicum maximum* showed that even ripe seed germinated irregularly over a period of six months.

The germination of *Panicum maximum* seed has been irregular and has, in no case, exceeded 3.75 per cent. No treatment other than oven-drying for three days at 40°C. has hastened germination and then only when the seed had been harvested dead ripe.

Germination tests were done on a number of samples of indigenous grass seeds for the Pasture Research Organization. These included tests on the effect of various chemical seed dressings on germination.

Many samples of grass seeds reach the laboratory with few ripened seeds and with a number of florets not having released their anthers.

Tests on pyrethrum seed treated with Agrosan and Fernasan showed that the latter tended to increase the final germination figure while Agrosan had a slightly depressing effect. Both fungicides prevented moulds forming on the seeds during the germination tests.

Seeds affected by fungi were referred to the Plant Pathology Laboratory.

Forty-eight species of plants were raised from unidentified weed seeds found in local and foreign seed samples. Twenty of these have been identified on reaching maturity and have been added to the reference collection together with sixteen from the previous years interceptions. Four hundred and one sheets have been added to the economic herbarium during the year.

Plant Disease Survey

Two hundred and fifty-three collections of micro-fungi were added to the mycological herbarium. One hundred and eighty-four collections were sent to the Commonwealth Mycological Institute, of which reports on one hundred and seventy-four have been received together with reports on fifteen of the collections sent the previous year.

The following determinations have been received:—

Acremoniella atra and *Actinomucor repens* on timber; *Aecidium crassocephali* on *Crassocephalum* sp., *A. crini* on *Crinum kirkii*, *A. crotalariae* on *Crotalaria* sp., *A. evansii* on *Lippia* sp., *A. nairobianum* on *Lippia ukambensis* and *L. asperifolia*, *A. solani-unguiculati* on *Solanum campylacanthum* and *Solanum* sp., *A. vangueriae* on *Vangueria* sp., *A. vernoniae-podocamae* on *Vernonia* sp.; *Alternaria sonchi* on *Sonchus asper*; *Aspergillus flavus* on *Saccharum officinarum*, *A. ustus* on timber, *Beniowskia sphaeroidea* on *Pennisetum polystachyon*; *Botrytis cinerea* on *Urena lobata*, *Bremia lactucae* on *Sonchus oleraceus*; *Cercospora beticola* on *Beta vulgaris*, *C. bidentis* on *Bidens pilosa*, *C. brachycarpa*

on *Solanum incanum*, *C. cluytiae* on *Cluytia abyssinica*, *C. heteromalla* on *Rubus steudneri*, *C. longipes* on *Saccharum officinarum*, *C. punicae* on *Panicum granatum*, *C. tessellata* on *Dactyloctenium aegyptium*; *Cicinnobolus cesatii* on *Oidium* sp.; *Cladosporium fulvum*, on *Lycopersicium esculentum*; *Cylindrosporium kilimandscharicum* on *Commelina* sp., *C. tephrosiae* on *Tephrosia candida*; *Cystopus bliti* on *Amaranthus tricolor*, *C. candidus* on *Capsella bursa-pastoris* and *Erucastrum arabicum*, *C. ipomoeae panduratae* on *Ipomoea* spp., *C. portulacae* on *Portulaca oleracea*, *C. tragopogonis* on *Helianthus annuus* and *Gerbera jamesoni*; *Darlucula filum* on *Puccinia kampalensis*; *Dendryphium atrum* on *Cupressus macrocarpa*; *Dimeriella claviseta* on *Vernonia* sp.; *Entyloma bidentis* on *Bidens pilosa*, *E. dahliae* on *Dahlia* sp., *E. physalidis* on *Physalis peruviana*; *Epicoccum purpurascens* on timber; *Exobasidium hesperidum* on *Rhus* sp.; *Fusarium dimerum* on timber, *F. equiseti* on *Cynodon plectostachyum*, *F. scirpi* var. *filiferum* on *Chrysanthemum cinerariifolium*; *Hamasporea longissima* on *Rubus* sp., *Helminthosporium turcicum* on *Zea mays*; *Hemileia holstii* on *Psychotria nairobiensis*, *H. woodii* on *Vangueria* sp.; *Hypoxylon truncatum* on dead wood; *Isariopsis griseola* on *Phaseolus vulgaris*; *Kordyana celebensis* on *Commelina benghalensis*; *Leveilula taurica* on *Tropaeolum majus*; *Melampsora euphorbiae-dulcis* on *Euphorbia pulcherrima*, *M. ricini* and *Mucor fragilis* on *Ricinus communis*; *Neurospora sitophila* on timber; *Peronospora parasitica* on *Erucastrum arabicum*; *Pestalotiopsis gigas* and *P. natrassii* on *Thea sinensis*, *P. glandicola* on *Magnifera indica*; *Phakopsora apoda* on *Pennisetum clandestinum*, *P. desmum* on *Gossypium* sp.; *Phyllachora milletiae* on *Milletia dura*; *Phytophthora infestans* on *Solanum indicum*, *S. incanum* and *S. panduraeforme*; *Piricularia grisea* on *Digitaria* sp.; *Pseudoperonospora cubensis* on *Cucumis sativa*; *Puccinia abutili* on *Abutilon longecuspe*, *P. aecidiiformis* on *Nidorella* sp., *P. aristidicola* on *Aristida adscensionis*, *P. asparagi* on *Asparagus officinalis*, *P. atropae* on *Withania somnifera*, *P. carthami* on *Carthamus tinctorius*, *P. chloridis* on *Chloris pycnothrix*, *P. chrysanthemi* on *Chrysanthemum sinensis*, *P. cnici-oleracei* on *Carduus kikujuorius*, *P. coronata* on *Avena sativa*, *P. dichondrae* on *Dichondra repens*, *P. erythraeensis* on *Hyparrhenia rufa*, *H. familiaris*, *H. hirta* and *H. lintonii*, *P. gerberae* on *Gerbera jamesonii*, *P. graminis* on *Dactylis glomerata*, *P. henriopsiana* on *Mariscus hemisphericus*, *P. heterospora* on *Sida rhombifolia*, *P. holosericea* on *Ipomoea* sp., *P. isoglossae* on *Hypoestis* spp., *P. kakamariensis* on *Sporobolus fimbriatus*, *P. kampalensis* on *Wedelia* sp., *P. leucadis* on *Leucas massaiensis*, *P. loudetiae* on *Loudetia kagerensis*, *P. malvacearum* on *Malva verticillata*, *P. oahuensis* on *Digitaria abyssinica*, *P. penniseti* on *Pennisetum verticillatum*, *P. polygoni-amphibii* on *Polygonum* sp. and *Oxygonum atriplicifolium*, *P. pruni-spinosae* on *Prunus persica*, *P. purpurea* on *Sorghum vulgare*, *P. thunbergiae-alatae* on *Thunbergia alata*, *P. tricholaenae* on *Rhynchelytrum repens*, *P. vernoniicola* on *Vernonia* sp., *P. versicolor* on *Themeda triandra*; *Ravenelia volkensii* on *Acacia* spp.; *Schroeteriaster doidgeae* on *Croton megalocarpus*; *Sclerospora sorghi* on *Sorghum vulgare*; *Septoria rubi* on *Rubus idaeus*, *S. sonchifolia* on *Sonchus asper*; *Sphacelia amarantida* on *Amaranthus tricolor*; *Syncephalastrum racemosum* (lab: contaminant); *Synchytrium aecidiodes* on *Amphicarpaea africana*; *S. dolichi* on *Glycine javanica*; *Trabutia evansii* on *Ficus hoestetteri* and *Ficus* sp.; *Trichoderma viride* on roots of *Jacaranda mimosaefolia* and *Pinus insignis*; *Uredo cryptostegiae* on *Cryptostegia grandiflora*; *U. scirpi-corymbosi* on *Scirpus corymbosus*; *Uromyces bidenticola* on *Bidens pilosa*, *U. chloridis* on *Chloris myriostachya*, *U. commelinae* on *Commelina benghalensis*, *U. dactyloenii* on *Dactyloctenium aegyptium*, *U. decoratus* on *Crotalaria* sp., *U. dianthi* on *Dianthus barbatus*, *U. elegans* (aecidium) on *Trifolium johnstoni*, *U. eragrostidis* on *Eragrostis heteromera*, *U. fabae* on *Lens esculentus*, *U. gladioli* on *Gladiolus* sp., *U. leptodermis* on *Brachiaria distachneura*, *U. orientalis* on *Indigofera* sp., *U. striatus* on *Medicago sativa*, *U. tenuicutis* on *Sporobolus pyramidalis*.

The Commonwealth Mycological Institute has been unable to assign specific epithets to the following collections which, presumably, represent undescribed species. The number following each name is that of Herb. I.M.I.:—

Aecidium on *Discopodium penninervium* 44194; *Alternaria* on *Tagetes minuta* 44106; *Alternaria* on *Chrysanthemum leucanthemum* 43404, *Ascochyta* on *Anona reticulata* 42231 and 42235; *Cercospora* on *Dioscorea* sp. 44291, *Cercospora* on *Erucastrum* sp. 43405, *Cercospora* on *Galinsoga parviflora* 44103, *Cercospora* on *Digitaria* sp. 41305, *Cercospora* on *Chlorophytum* sp. 42234; *Cercospora* on *Coccinea grandis* 44281; *Cylindrosporium* on *Commelina* sp. 43408; *Endothella* on *Albizzia* sp. 41068; *Helminthosporium* on timber 41304 *Leveillula* on *Euphorbia pulcherrima* 39647 and 41067; *Mycosphaerella* on *Oenanthë palustris* 44533; *Myxosporium* on *Cupressus macrocarpa* 40097; *Phomopsis* on *Cassia siamea* 42241; *Phyllachora* on *Garcinia livingstonei* 44195; *Polystigminia* on *Albizzia* sp. 41515; *Puccinia* on *Cissus* sp. 44192, *Puccinia* on *Cyathula uncinulata* 42245, *Puccinia* on *Dombeya nairobiensis* 43029, *Puccinia* on *Vernonia cistifolia* 43523; *Ramularia* on *Vigna* sp. 44292; *Rhynchosphaeria* on *Cupressus macrocarpa* 40096; *Septoria* on *Lysimachia africana* 44532; *Uredo* (*Hemileia*) on *Mandevillea* sp. 43518; *Uromyces* on *Thalictrum rhynchocarpum* 44191.

R. M. NATTRASS,
Senior Plant Pathologist.

ANNUAL REPORT, CHEMICAL SECTION, 1950

Research and Investigation

PHOSPHATE TRIALS

The biological assays carried out during 1949 on the availability of different phosphatic fertilizers were continued during the year.

POT CULTURES

The results of the 1949 Highland and Native Fertilizer Experiments had once again confirmed that on most local soil types many arable crops showed a marked response to "readily available" phosphatic fertilizers. In these trials too (particularly in those carried out in the European Highlands), superphosphates had produced markedly greater responses than equivalent applications of the locally produced sodaphosphate. On the other hand, pot culture work carried out by the Chemical Section during 1949 had indicated that early uptake of phosphate by cereal and grass seedlings from sodaphosphate was much the same as that from superphosphates, that the uptake from sodaphosphate continued longer than from superphosphates, and that the growth effect of the two fertilizers was similar, provided that the plant roots were not confined to a medium containing a high concentration of fertilizer. When, however, the plant roots were so confined, phosphate uptake from sodaphosphate was depressed when the sodaphosphate content of the medium exceeded the equivalent of about 0.4 per cent citric soluble P_2O_5 ; phosphate uptake from superphosphate was not depressed even when the superphosphate content of the medium was as high as the equivalent of 5 per cent P_2O_5 . Evidence was adduced that method of placement may have an important effect on the relative effectiveness of the fertilizers.

Pot culture trials were carried out in 1950 with the aims firstly of confirming the 1949 observations on the effect of different methods of placement on the uptake of phosphates from superphosphates and from sodaphosphates, and secondly of investigating the effect of varying the concentration of sodaphosphate within the fertilized zone on the efficiency of this fertilizer.

In all trials, rye was used as the indicator crop. All trials were carried out in wooden boxes measuring 40 in. by 16 in. by 7 in., containing a 5-in. layer of soil weighing approximately 120 lb., of a Kikuyu Red Loam ex Scott Agricultural Laboratories, which was known to be deficient in phosphates and which was known to have high phosphate fixation powers. Each box was planted with six rows, each of 32 seeds, the spacing between the rows being 7 in., and between the seeds in the row being $\frac{1}{2}$ in. Factors not under investigation were standardized as far as practicable, and a measure of variability within each trial was obtained by the use of two controls in each set of treatments. Other treatments were, however, not replicated. In most cases, only the middle four rows were harvested and analysed. At 20 to 26 days after seeding, the few poorly developed plants to be found among their more vigorous companions were removed and from the remainder approximately alternate seedlings were harvested, 16 plants being left in each row. At 34 to 42 days after seeding, a further eight plants were harvested from each row by taking alternate plants; a 49 to 62 days after seeding, at which stage many of the remaining plants were coming into ear, all the plants were harvested. In all cases plants were harvested by cutting at ground level and collecting aerial parts. The boxes were kept free of weeds and the stumps of already harvested plants were cut back as required to prevent their re-growth. All boxes were watered as required, an even watering with a dilute solution of ammonium nitrate normally being given once every week. At each harvest, the number of plants taken from each box, their dry weight and their phosphate content were among the determinations made. Though the plants generally grew well, there were considerable variations between trials. In consequence, there were considerable differences between the ages at which the trials were harvested. The form

of superphosphate used was triple-superphosphate containing 48 per cent P_2O_5 , and the sodaphosphate was from a sample containing 17.6 per cent citric soluble P_2O_5 and 2.8 per cent free sodium carbonate. Except where otherwise stated, the concentration of added available phosphates (expressed as total P_2O_5 in the case of triple superphosphate and as citric soluble P_2O_5 in the case of sodaphosphate) was 100 parts per million of the soil placed in the box, while the concentration of added available phosphates (expressed in the same way) in the fertilized zones in each box were 840 parts per million. The P_2O_5 content of this seed was between 0.25 and 0.33 mg. per seed.

In the first trial, sodaphosphate and triple-superphosphate were compared with one another and with a "no phosphate" control, and placement of the fertilizers beneath the rows at a depth of $\frac{1}{2}$ in. was compared with placement between the rows at a depth of 1 in. The following gives the essential data obtained:—

Date of seeding	.. ..	3-2-1950
Date of 1st harvest	.. ..	23-2-1950
Date of 2nd harvest	.. ..	9-3-1950
Date of 3rd Harvest	.. ..	23-3-1950

	CONTROL	SODAPHOSPHATE		SUPERPHOSPHATE	
	(mean of 2)	beneath rows	between rows	beneath rows	between rows
OVEN DRY WEIGHT, PER SEEDLING, IN GRAMS					
1st Harvest	0.071	0.135	0.121	0.153	0.116
2nd Harvest	0.196	0.355	0.417	0.372	0.399
3rd Harvest	0.341	1.260	1.305	1.182	0.906
% P205 IN DRY MATTER					
1st Harvest	0.77	?	?	?	?
2nd Harvest	0.37	1.00	0.74	0.81	1.01
3rd Harvest	0.30	0.57	0.57	0.58	0.56
P205 UPTAKE PER SEEDLING, IN MGMS.					
1st Harvest	0.55	?	?	?	?
2nd Harvest	0.72	3.54	3.08	3.01	4.04
3rd Harvest	1.03	6.67	6.81	6.80	5.07

The dry matter yields of both the sodaphosphate and the superphosphate treated boxes were markedly greater than those of the "no phosphate" control even at the first harvest, while the differences became even more pronounced as the plants became more mature. The differences in the later, and particularly the third harvest, were, in part at least, due to the earlier maturing of the phosphate-treated plots. Even greater differences between the phosphate treated and the control plots were shown in phosphate uptake. The dry weight and phosphate uptake of sodaphosphate treated seedlings was again slightly higher than that of the superphosphate treated seedlings.

In the second trial, the residual effects of the treatments of the first trial, were measured on a second crop of seedlings. The following gives the essential data obtained:—

Date of seeding	.. .. .	24-3-1950
Date of 1st harvest	.. .. .	19-4-1950
Date of 2nd harvest	.. .. .	25-5-1950

	CONTROL		SODAPHOSPHATE		SUPERPHOSPHATE	
	(mean of 2)	beneath rows	between rows	beneath rows	between rows	
OVEN DRY WEIGHT, PER SEEDLING, IN GRAMS						
1st Harvest	0.052	0.082	0.085	0.078	0.086	
2nd Harvest	0.57	0.59	0.60	0.73	0.70	
% P205 IN DRY MATTER						
1st Harvest	0.35	0.72	0.73	0.71	0.70	
2nd Harvest	0.29	0.39	0.43	0.38	0.39	
P205 UPTAKE PER SEEDLING, IN MGMS						
1st Harvest	0.18	0.59	0.61	0.57	0.61	
2nd Harvest	1.65	2.33	2.55	2.79	2.78	

Growth, dry matter yields, and phosphate uptake were markedly poorer, and the effects of the added phosphates was markedly smaller than in the first trial. The relatively small superphosphate and the still smaller sodaphosphate effect on the oven-dry weight per seedling in the final harvest, at a time when there were still supplies of available phosphates in the treated boxes, indicates that some factor other than phosphates was limiting growth. There is obvious need for further examination of residual phosphate effects by direct comparison with newly manured seedlings as well as "no phosphate" controls. The greater residual effect of sodaphosphate which had been reported in the 1949 Report for Rhodes grass and wheat seedlings, is not confirmed by the results of this trial.

In the third trial, the effect of different concentrations of sodaphosphate within the fertilized zone, were compared with one another and with a "no phosphate" control. The fertilized zone was 2 in. wide and placed beneath the rows of seedlings at a depth of $\frac{1}{2}$ in. The following gives details of the concentrations of sodaphosphate used, together with the essential data obtained:—

Date of seeding	15-6-1950
Date of 1st harvest	5-7-1950
Date of 2nd harvest	26-7-1950
Date of 3rd harvest	9-8-1950

		CONTROL (mean of 2)	RATE OF ADDITION OF SODAPHOSPHATE, EXPRESSED AS WEIGHT OF CITRIC SOLUBLE P205 PER 100 UNITS SOIL					
			Un- diluted	3.2	1.6	0.8	0.4	0.1
OVEN DRY WEIGHT PER SEEDLING, IN GRAMS								
1st Harvest ..	..	0.058	0.063	0.059	0.067	0.067	0.075	0.067
2nd Harvest ..	..	0.12	0.13	0.13	0.12	0.13	0.16	0.15
3rd Harvest ..	..	0.29	0.35	0.28	0.29	0.32	0.35	0.34
% P205 IN DRY MATTER								
1st Harvest ..	..	0.36	0.74	0.62	0.63	0.82	0.76	0.86
2nd Harvest ..	..	1.07	1.45	1.73	1.12	1.45	1.61	1.40
3rd Harvest ..	..	0.64	0.80	0.97	0.83	0.92	0.82	0.65
P205 UPTAKE PER SEEDLING, IN MGMS.								
1st Harvest ..	..	0.21	0.46	0.37	0.42	0.55	0.57	0.59
2nd Harvest ..	..	1.53	1.88	2.22	1.71	1.86	2.52	2.04
3rd Harvest ..	..	1.88	2.84	2.71	2.60	2.95	2.86	2.19

Growth, dry matter yields, and phosphatic uptake were again markedly poorer and the effects of added phosphate markedly smaller than in the first trial.

Further examination of the effect of varying the concentration of added sodaphosphate within the fertilized zone was therefore carried out in the fourth trial.

Under the growing conditions prevailing in the third trial, the phosphate uptake at all levels of concentration of the fertilizer within the fertilized zone was higher than in the "no phosphate" control, but no relationship was apparent between P_2O_5 uptake and concentration of sodaphosphate within the fertilized zone. The oven-dry weights per seedling showed little response to the fertilizer at any of the levels examined.

In the fourth trial, using the same location of the fertilized zone as was adopted in the third trial, confirmation of the results of the third trial was sought, and the effects of different overall concentrations of sodaphosphate in the growing medium were compared with one another and with a "no phosphate" control.

The following gives details of the treatments adopted, together with the essential data obtained:—

Date of seeding	.. ..	19-10-1950
Date of 1st harvest	.. ..	9-11-1950
Date of 2nd harvest	.. ..	23-11-1950
Date of 3rd harvest	.. ..	11-12-1950

Overall concentration of Sodaphosphate as parts citric soluble P205 per million	CONTROL	RATE OF ADDITION OF SODAPHOSPHATE EXPRESSED AS WEIGHT OF CITRIC SOLUBLE P205 PER 100 UNITS OF SOIL IN THE FERTILIZED ZONE					
	(mean of 2)	Undiluted		3:2		0:2	
		200	100	200	100	200	100
		OVEN DRY WEIGHT PER SEEDLING, IN GRAMS					
1st Harvest	0.069	0.105	0.114	0.117	0.091	0.103	0.123
2nd Harvest	0.29	0.49	0.45	0.45	0.38	0.41	0.45
3rd Harvest	1.04	1.33	1.49	1.78	1.17	1.36	1.21
		% P205 IN DRY MATTER					
1st Harvest	0.83	1.65	1.40	1.59	1.56	1.95	1.58
2nd Harvest	0.58	0.86	0.88	1.09	1.08	1.23	1.09
3rd Harvest	0.54	0.83	0.77	0.91	0.94	1.09	0.96
		P205 UPTAKE PER SEEDLING, IN MGMS.					
1st Harvest	0.56	1.74	1.59	1.88	1.61	2.01	2.01
2nd Harvest	0.86	2.05	1.95	2.44	2.05	2.55	2.44
3rd Harvest	1.73	2.37	2.03	2.77	2.74	3.12	2.84

Growth showed a considerable improvement over trials two and three, and phosphate uptake was much greater. Differences between the phosphate treated plots and the controls both in oven-dry yields and phosphate uptake were most marked early in growth, but tended to become less marked during the later stages of growth. This tendency probably arose from the comparative uniformity with which the crop under all treatments, approached maturity. Oven-dry yields showed no relationship with concentration of sodaphosphate within the fertilized zone or with overall phosphate concentration in the growth media. On the other hand, at both levels of overall phosphate concentration, phosphate uptake became greater as the concentration of sodaphosphate within the fertilized zone was reduced and, at all levels of sodaphosphate concentration within the fertilized zone, the phosphate uptake from the more heavily fertilized treatments was consistently as high or higher than that from the less heavily fertilized treatments.

When the third harvest of this trial had been completed, thin layers of soil from beneath representative rows of certain of the treatments were examined for pH and Walkley and Black Organic Carbon, the following results being obtained:—

TREATMENT

DEPTH	OVERALL CONCENTRATION OF P2O5: 200 PARTS PER MILLION. CONCENTRATION IN FERTILIZED ZONE							
	CONTROL		0.2 per cent		3.2 per cent		Undiluted	
	pH	Carbon %	pH	Carbon %	pH	Carbon %	pH	Carbon %
0-1/2 in.	6.48	2.25	6.14	2.25	5.83	2.25	6.50	2.22
1/2-5/8 in.	*6.18	2.24	6.05	2.27	6.61	2.31	7.26	2.37*
5/8-3/4 in.	6.12	2.22	6.72	2.24	7.32	2.25	8.29	2.18
3/4-7/8 in.	6.27	2.21	7.22	2.16	7.56	2.28	7.85	2.29
7/8-1 in.	6.30	2.22	7.35	2.23	7.56	2.22	8.10	2.20
1 in.-11/8 in.	6.19	2.18	6.85	2.16	7.55	2.20	7.95	2.15
11/8 in.-	5.96	2.13	6.35	2.25	6.28	2.16	6.38	2.25

(* = Top of fertilizer)

The samples from the sodaphosphate fertilized zones and their environs were markedly more alkaline than the corresponding samples from the control, the difference being greater at the higher levels of concentration of sodaphosphate within the fertilized zone. At the same time, even the highest individual pH recorded (8.29) is within the range in which successful crop growth is possible, and (assuming that the organic status of each sample examined is a measure of root development in the sample) there is no indication that such localized alkalinity as did exist had any deleterious effect on root development.

An attempt was also made to study root distribution after the third trial, but the direct measurements which were then made furnished unreliable results.

The results of the 1950 trials confirmed the observations reported in 1949 that sodaphosphate, under the conditions that prevailed during the trials, is at least as effective as the equivalent dressing of triple-superphosphate in stimulating the growth and phosphate uptake of certain young gramineous seedlings. At the same time, there is some indication (notably in the fourth trial) that a high concentration of sodaphosphate in the fertilized zone can depress phosphate uptake by seedlings and through this it may lead to the lower yields which have been frequently obtained in field trials of sodaphosphate against the equivalent dressing of superphosphate. Accordingly, a micro-field trial is planned for 1951 with the aim of correlating various concentrations of sodaphosphate and superphosphates in the fertilized zone, with phosphate uptake by cereal seedlings and with final yield.

FIELD STUDIES IN PHOSPHATIC FIXATION

In 1949 there was reported a field trial started at the Scott Agricultural Laboratories on 29th October, 1948. In this trial the responses of Nzoia Rhodes grass to a dressing of Uganda Rock Phosphate giving 500 lb. total P_2O_5 per acre, and to dressings of sodaphosphate and triple-superphosphate, giving respectively 250 lb. total P_2O_5 per acre, were compared with one another and with a "no phosphate" control. Growth on all phosphate fertilized plots was markedly more vigorous, and early phosphate uptake in the superphosphate, sodaphosphate, and, to a somewhat smaller extent, in the rock phosphate treatments was much greater than in the controls. There was also a marked residual effect of the treatments six months after fertilizing, particularly in the case of sodaphosphate.

Further samples were harvested from this trial in 1950, and from the cuts taken, the following data was obtained:—

Date of Harvest	Growing Conditions		Control (Mean of 6)	Rock Phos. (Mean of 3)	Soda Phos. (Mean of 3)	Super Phos. (Mean of 3)
3/2/50 ..	Hot/Dry ..	Yield in gms. dry matter per plot ..	1,805	1,826	1,969	1,942
		% P205 in dry matter ..	0.29	0.30	0.33	0.30
		P205 uptake in gms. per plot ..	5.24	5.48	6.41	5.87
17/5/50 ..	Warm/Wet	Yield in gms. dry matter per plot ..	7,440	7,580	6,600	6,790
		% P205 in dry matter ..	.27	.30	.33	.29
		P205 uptake in gms. per plot ..	20.05	22.23	22.10	19.53
28/8/50 ..	Cool/Dry	Yield in gms. dry matter per plot ..	4,703	5,096	5,417	4,747
		% P205 in dry matter ..	0.23	0.20	0.24	0.23
		P205 uptake in gms. per plot ..	10.85	10.08	12.82	10.88
28/11/50	Warm/Wet	Yield in gms. dry matter per plot ..	2,235	2,211	2,628	2,218
		%P205 in dry matter ..	0.35	0.37	0.39	0.39
		P205 uptake in gms. per plot ..	7.83	8.22	10.38	8.60

A small residual effect from sodaphosphate only was apparent in 1950. The trial is being continued in 1951, using more critical assay material.

NITROGEN STUDIES

The analysis of samples of daily rainfall at the Scott Agricultural Laboratories for ammoniacal nitrogen which was started in 1949 was continued throughout 1950, the work being extended to include the analysis for ammoniacal nitrogen, and nitrate nitrogen of bulked monthly samples submitted by a number of out-stations. The following summarizes the results obtained in respect of the stations which submitted the most complete collection of samples:—

Stn.		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
Scott Agric. Labs.	Rainfall in ins.	1.86	0.25	4.76	8.72	2.17	0.83	0.16	1.54	0.38	2.01	3.17	0.43
	Ammoniacal N. added by rain lb./acre	.11	.01	.31	.50	.12	.03	.02	.19	.04	.19	.16	.01
Agric. Dept. Ol Joro Orok	Rainfall in ins.	.85	.05	1.04	.95	1.75	—	7.45	2.72	1.25	1.17	—	.48
	Ammoniacal N. added by rain lb./acre	.06	—	.09	.07	.09	—	.54	.18	.09	.15	—	.06
	Nitrate N. ad- ded by rain lb./acre ..	.03	—	.02	.01	.02	—	.12	.04	.02	.02	—	.01
Agric. Dept. Kitale	Rainfall in ins.	.08	.03	2.37	4.60	2.15	7.95	10.12	3.21	5.09	5.95	—	—
	Ammoniacal N. added by rain lb./acre	—	—	.39	.30	.15	.63	1.14	.30	.70	.55	—	—
	Nitrate N. ad- ded by rain lb./acre ..	—	—	.04	.05	.02	.10	.07	.05	.03	.13	—	—
Agric. School Embu	Rainfall in ins.	—	—	9.95	15.54	5.41	3.25	2.44	1.67	0.80	4.46	6.26	—
	Ammoniacal N. added by rain lb./acre	—	—	.72	.35	.31	.21	.23	.23	.09	.60	.71	—
	Nitrate N. ad- ded by rain lb./acre ..	—	—	.07	.25	.06	.04	.06	.04	.01	.04	.13	—

Fairly wide fluctuations in the apparent ammoniacal and nitrate contents of individual samples was again observed. Nevertheless, the average addition of both forms of nitrogen per acre per inch of rain, showed a broad similarity between stations. The figures for ammoniacal nitrogen resemble those reported in 1949, but the figures for nitrate nitrogen are very much lower. Average data in respect of the stations reported above are:—

STATION	MEAN ADDITION IN LB. PER ACRE PER INCH RAIN OF NITROGEN AS:—	
	NH ₃	NO ₃
Scott Agricultural Laboratories ..	0.063	—
Agricultural Dept., Ol Joro Orok ..	0.075	0.017
Agricultural Dept., Kitale	0.100	0.012
✓ Agricultural School, Embu ..	0.070	0.014

Detailed examination of the data showed that ammoniacal nitrogen tended to be present in higher than average concentrations at all stations in March, and at both the Scott Agricultural Laboratories and Embu, in the season July to October or November, but that there was not such a marked seasonal variation at either Kitale or Ol Joro Orok. Confirmation of interaction between locality of collection of the samples and seasonal effect is being sought in 1951. Meanwhile, the 1950 work confirmed the smallness of the addition of mineral nitrogen to local soils in the rainfall which had been reported in 1949.

SOIL SURVEYS

Soil survey work in 1950 was confined to the following rapid surveys:—

(1) Of a riparian area on the River Turkwell near Lodwar in connexion with proposals for the development of irrigation there. The soils concerned were mainly very recent alluvial buff-coloured loams.

(2) Of areas in southern Machakos which had been proposed for settlement. The soils concerned were mainly sandy loams of volcanic and metamorphic origin.

(3) Of areas of the Laikipia Plains in connexion with examination of factors influencing bush encroachment. The soils concerned were mainly clay loams derived from old lake-bed formations. The main species involved—*Acacia drepanolobium*—was associated with the heavier, darker soil in more sheltered sites, grass being dominant where the soils were lighter, greyer and more acid, and the sites more exposed.

And to reporting on sandy soils from coastal areas between Kilifi and Malindi whose development for coconut production was mooted.

SOIL FERTILITY STUDIES

Rehabilitation of Upper Molo Wheatlands.—Pot culture studies were carried out on certain soils from Upper Molo with the aim of advising on suitable treatments for incorporation in trials there, having as their aim the successful re-establishment of productive grasses after several years of wheat monoculture. Preliminary examination in the laboratory of soil samples representative of the area revealed that the main measured characteristic of land which was still under cultivation after numerous wheat crops had been taken was its low degree of aggregation into crumbs. Initial pot culture trials, however, showed that, under laboratory conditions at least, nutrients are more important than structure and that, without fertilizing, growth even on soil from new land was poor. Later examination of actual fertilizer requirements showed that the dominant need is for phosphates. This finding is in accord with local experience that successful cereal production is possible only by use of readily available phosphatic fertilizers, and was later confirmed by field trials in this area.

LAND RESTING STUDIES, ETC.

An observation trial on the fertility building effects of contrasting resting crops on Kikuyu Red Loam at the Scott Agricultural Laboratories was laid out during the 1950 long rains. The resting crops used were Rhodes grass, Kudzu vine, Kikuyu grass, Natural regeneration, Napier grass, and seasonal green manure crops. Quadruplicate marked sites were sampled soon after planting and all top soils so collected were submitted to a wide range of laboratory estimations. Further samples will be submitted to similar estimations when the trial area is brought back into arable cropping and at regular intervals thereafter.

The Rhodes grass was quickly established, made good growth and was grazed as required during both the long and short rains seasons. The natural regenerations quickly sprang into a mass of weeds in which grasses have been slow to establish themselves. The two crops of Sunn hemp which have been sown on the Seasonal Green Manure plots have made rather poor uneven growth. The Kikuyu grass, the Napier grass and particularly the Kudzu have been very slow in becoming established and producing a ground cover.

An observation trial on the growth of different crops during the first year after breaking Rhodes grass pasture was also undertaken, but, owing to past erosion, the field concerned was exceedingly heterogeneous and at a rather low level of fertility; in consequence growth was rather poor and uneven and no comparison between crops was possible. However, the unevenness of growth presented an opportunity to seek relationships between measurable soil characteristics and vegetative production. For this comparison, the strips of each crop were divided into 4½-yard sided squares, the yields of each of which being recorded separately. The hay yield per square, adjusted where necessary for the loss of producing area to soil conservation works, was taken as the measure of vegetative productivity. From the data so obtained squares were arranged in order of productivity, the resultant lists being divided into six yield groups each of equal population. The yield limits of each group were used as a basis for producing a plan of the fertility distribution within the field. Soil samples were taken in reference to the fertility pattern so recorded, with the aim of obtaining topsoils from a range of fertility levels. The essential data in respect of the samples so obtained are as follows:—

Crop	Yield lb.	Top Soil Depth	pH	EXCHANGEABLE BASES M.E. %			N %	Organic Matter %	Absorbed and acid Sol. P205 %
				CaO	MgO	K2O			
CLASS 1—		in.							
Maize ..	85	8	5.2	6.6	2.4	2.7	.24	4.9	—
Sunflower ..	139	12	5.3	6.4	4.0	2.4	.16	4.5	.015
Sunn Hemp:									
Flowering ..	79	8	5.3	4.9	4.0	2.4	.17	3.2	.012
Mature ..	43	9	5.8	10.1	3.2	2.3	.23	4.7	—
CLASS 3—									
Maize ..	52	9	5.3	5.9	2.6	2.1	.18	4.4	—
Sunflower ..	89	7	4.9	3.5	2.8	1.7	.15	4.9	.011
Sunn Hemp:									
Flowering ..	55	8	5.0	5.3	4.7	2.0	.19	4.6	.012
Mature ..	30	10	5.1	5.7	2.8	1.8	.19	4.9	—
CLASS 6—									
Maize ..	32	7	5.2	3.7	2.4	2.5	.22	4.3	—
	19	7	4.7	2.8	2.6	1.3	.15	3.1	—
Sunflower ..	55	8	4.8	4.5	3.1	1.7	.15	4.0	.012
	24	8	5.2	3.9	3.5	1.4	.17	4.0	.016
Sunn Hemp:									
Flowering ..	24	9	4.6	4.2	3.3	1.6	.17	3.7	.010
Mature ..	8	8	4.6	3.7	1.9	1.2	.17	3.7	—

A low pH and base nitrogen and organic matter status is shown as being associated with low yields, though the level of fertility indicated by the analysis and actual yields even of the class 1 squares themselves was low. In continuation of this work, a critical trial incorporating manurial treatments and times of breaking is planned for 1951.

Further aggregate analyses were carried out on soil samples from the Kitale Experimental Station crumb structure grass plots, but once again, no consistent differences were observed between treatments. Subsequent examination of the plots themselves showed them to be in an unsuitable condition for further work based on them to be warranted. Accordingly, the present investigation has been abandoned and will be replaced by an investigation based on a more elaborate trial proposed for the Kitale Pasture Research Station.

A series of soil samples from the large Pyrethrum Rotation Trial at Ol Joro Orok was subjected to detailed laboratory examination, the mean results obtained being:—

	1st year pyrethrum after 3 years pyrethrum, not manured	1st year pyrethrum after 3 years pyrethrum, manured compost plus phosphates	1st year pyrethrum after 3 years grass, not manured, but grazed
Exch. CaO per cent ..	·20	·18	·19
Exch. K ₂ O per cent ..	·029	·054	·078
Exch. MgO per cent ..	·063	·061	·061
Total N per cent ..	·23	·23	·26
Conductivity of a 1/5 soil/water suspension, relative to N/10 K Cl as 1			
First day ..	·127	·164	·131
7 day increase ..	·02	·07	·05
Dry aggregates per cent—			
greater than 3mm. ..	8·1	9·7	10·1
greater than 2mm. ..	14·0	16·3	17·6
greater than 1mm. ..	32·7	36·3	38·6
greater than ½mm. ..	48·1	52·7	56·2
Water stable aggregates greater than ½mm. ..	19·3	22·7	29·1

The data in respect of N per cent and water stable aggregates were analyzed statistically and the value for the pyrethrum after grass treatments in each case was found to be highly significantly greater than the other treatments; the differences between the values for the manured and the unmanured plots were not significant. The broad conclusion was reached that though the pyrethrum after grass yields recorded in the trial had been disappointing, the grass had brought about a definite superiority in many measurable factors normally associated with soil fertility.

Analyses for oven-dry weight and crude protein were carried out on wheat plants at an early flowering stage of maturity drawn from certain plots in the Small Pyrethrum Rotation Trial at Ol Joro Orok. Details of treatments and mean data are:—

TREATMENT	Dry weight per plot gms.	Per cent Crude Protein in Dry Matter	Crude Protein per Plot gms.	Final yield of grain, bags per acre
1st year wheat after 2 years' grass ..	627	9·3	57·0	7·90
As above plus 80 lb./acre Sulphate of ammonia, 44 days after sowing ..	760	11·5	88·3	6·51
1st year wheat after 4 years' pyrethrum ..	797	11·3	89·8	5·58
2nd year wheat after 3 years' pyrethrum ..	839	10·6	90·5	6·05

An analysis of the data by Mr. Gaddum, Senior Agricultural Officer (pyrethrum), showed that the difference between the yield of dry matter of wheat after grass and wheat after pyrethrum was significant, and that the differences between per cent crude protein in dry matter and yield of crude protein between the fertilized and unfertilized, and between the wheat after grass and wheat after pyrethrum treatments were highly significant. On the other hand, entirely different relations were found between the final grain yields and the treatments.

A laboratory study was undertaken of soil factors influencing the relative dominance of *Pennisetum schimperii* and Star grass at high altitudes. From its indications were obtained that adequacy of available phosphates and exchangeable calcium, and moderate, not extreme, acid conditions all operate in favour of Star grass. Field trials to test these observations are at present under consideration.

A series of samples taken in Trans Nzoia showed a dominance of Star grass, this time in the presence of *Digitaria* spp., *Hyparrhenia* spp. and *Londetia karagensis*, under similar conditions.

A series of soils were examined from the ridge and furrow experiment at Ol Joro Orok. A typical profile of the vlei concerned is:—

	DESCRIPTION	pH	N per cent	Organic Matter per cent	P205	Perme- ability cms./hr.	Pore Space	% V/V expansion on wetting
0-4 in. ..	Light, greyish brown sandy loam ..	5.5-5.7	26-30	6.9-7.5	low	9-11	—	—
4-12 in. ..	Markedly orange, mottled, sandy clay loam ..	5.7-6.5	11-17	2.2-3.9	low	3.4	—	—
12-20 in.	Coarse murram conglomerate ..	5.8-6.5	—	—	—	v. high	about 43	about 4
2 in. plus..	Plastic clay loam ..	6.2-6.5	—	1.4-2.5	low	less than 1	43-53	41-50

Similar data was found in respect of soils from a drainage experiment at Londiani.

COMPOSITION OF PLANT MATERIALS

The building up of a record of the composition of local plant products analysed in the laboratory was continued, the following being of particular interest in virtue of their possibilities as stock feed:—

Product	Moisture	Ash	Crude Protein	Ether Extract	Crude Fibre	Remarks
Wheat hay ..	7.9		6.9			Over mature
Oat hay ..	9.0		5.6			Over mature
Velt hay (Trans Nzoia) ..			4.6			Over mature
Lucerne Hay ..	14.6		20.9			Dried in pyrethrum drier.
Lucerne	17.7	7.8	15.4		24.8	Cut at full flowering.
Lucerne	32.0	8.0	17.8		12.5	Cut before flowering.
Maize silage. ..	71.9		6.2	0.2	22.5	
Oat silage. ..	50.0		7.3	0.4	35.2	
Velt silage (Trans Nzoia) ..	62.6		1.9			Over mature
Sunflower Head Bran ..	12.1		6.5			
Yellow Corn-on-Cob Meal ..	10.5	1.3	7.8	3.4	8.4	
Maize Meal ..	18.8		10.4	3.7	2.4	
Cassava ..	9.6-10.2	3.0-3.2	2.6-3.3	0.4-0.7	2.5-4.2	
Cassava Skins ..	10.0	5.4	5.9	0.9	7.9	Contains high proportion cyanogenetic glucoside.
Lupin seed ..	9.5		29.0			Some strains contain lupin alkaloids.
Simsim Cake ..	11.5		34.8	7.8		
Cottonseed Cake ..	9.3		11.4	7.5		
Sheanut (Yav) Cake ..	6.6	6.1	16.2	9.9	4.9	
Gram-winnings ..	9.9	3.8	22.1	3.8	20.2	
Gram husk ..	9.8	3.8	8.4	2.3	42.2	
Vegetable Ivory (Dour palm nuts) shavings..	9.8	1.3	4.6	1.0	17.4	Probably of very low digestibility.

The possibility of using papain for "in vitro" estimations of protein digestibility was examined and a promising method of estimation worked out. Shortage of papain prevented further development and testing of the method.

Numerous laboratory estimations of nicotine in tobacco and of nitrogen in barley were carried out in connexion with the breeding work. Numerous moisture estimations on cereal grains were carried out in connexion with departmental field trials, and grain storage experiments. Roasting temperatures and extraction procedures for chicory were investigated.

Work was continued on Everlasting Pea (*Lathyrus latifolius*), the main aim being to obtain information regarding suitable cutting intensities for this crop. From the results of the trial, it appears that in seasons of adequate rainfall two cuts, yielding about 4,000 lb. of dry matter including 1,000 lb. crude protein, and in seasons of low rainfall, one cut, yielding 1,400 lb. dry matter, including 270 lb. crude protein per acre are possible. Samples of hay have been supplied to the East African Veterinary Research Organization for digestibility trials.

A detailed investigation of the distribution of the major nutrient elements within the sisal leaf, and the influence which the position of the leaf on the plant and the age of the sisal plant, has on this distribution was carried out during the year. The following tentative conclusions regarding healthy plants have been drawn from the data so accumulated:—

- (1) At all plant ages examined, and at all positions on the plant, the concentration within the leaf of calcium, magnesium, nitrogen and phosphorus is greater towards the tip than the base.
- (2) Prior to poling, the concentration of potassium within the leaf is fairly uniformly distributed within the leaf. On a poled plant, however, the tendency is for the concentration of potassium towards the tip of the leaf to become greater than towards the base.
- (3) Phosphates concentration within the leaf as a whole shows a slight tendency to decrease with age of leaf on the plant. Otherwise no relation is apparent between the position of the leaf on the plant and its composition.
- (4) Age of plant has little effect on the concentration of the major nutrient elements within the leaf.
- (5) Within the growing point, the concentration of the major nutrient elements shows little variation with degree of development of the leaf.

(These conclusions refer to the dry matter of the leaf.) Ultimate statistical analysis of the data by co-variance procedure is envisaged.

An investigation was undertaken into the effect of method of decortication on the acidity, buffering capacity, fineness, and strength of sisal fibres, and the following conclusions were drawn from the data so accumulated:—

- (1) The acidity of water in contact with sisal fibres is not influenced by the method of preparation of the fibres examined.
- (2) The buffering capacity of fresh, unwashed fibres is lost if the fibres are washed while still wet from the decortication, or if they are dried and stored.
- (3) There is a prolonged slow release of acidic material from all classes of fibres examined when they are in contact with alkaline, neutral or slightly acid media.
- (4) Washing has little effect on fibre strength and fineness, but storage appears to bring about some increase in strength.

This investigation was undertaken as part of an examination of the relative quality of hand-decorticated African-produced fibre and of machine-decorticated estate-produced fibre.

Research and Investigation (Pyrethrum) (Mr. J. Hopkins)

"The two main fields in which work has been undertaken are (1) methods of analysis and (2) depreciation and storage losses in pyrethrum.

At the beginning of the year, owing to a change of contractual policy on the part of the Pyrethrum Board, the method of analysis of the Association of Official Agricultural Chemists of the U.S.A. superseded the Seil method. As a result of this change an investigation was instituted to reveal certain discrepancies in this method as it was noted that the procedure detailed by the A.O.A.C. differed from that of the originators of the method and from the procedure adapted by the Imperial Institute and other British workers.

In the A.O.A.C. version of the method, as published in the 6th edition, 1945, of their method of analysis, acidification of the saponified solution to liberate the chrysanthemum acids is carried out with sulphuric acid and excess barium, precipitated as sulphate, is removed by filtration on a Buchner filter. The British version, however, utilized hydrochloric acid and there is consequently no filtration necessary, excess barium remaining in solution as chloride. A series of comparative analyses carried out by both methods simultaneously revealed the fact that appreciably lower results are obtained for pyrethrin I by the A.O.A.C. method. In collaboration with the Scientific Adviser to the Pyrethrum Board it was ascertained that the low results obtained by the A.O.A.C. method were due to an actual loss of chrysanthemic acid during the filtration, moreover, it was shown that the chrysanthemic acid absorbed on the filter could be quantitatively recovered by extraction with dilute aqueous alkali. It appears therefore, that the A.O.A.C. method is at fault and that the Imperial Institute version is the correct one. A preliminary report has been submitted to the referee to the Association of Official Agricultural Chemists and to the Imperial Institute and a paper giving details of the investigations is being submitted for publication.

Throughout the year samples of all consignments of pyrethrum arriving in America have been returned to the Scott Laboratories by air. It has thus been possible to maintain a record of the dispatched and landed content of each consignment and to calculate the transit losses incurred. These have proved to be very considerable, depreciation of 10.4 per cent to 24.4 per cent of the original pyrethrin content having been recorded. It has further been shown that originally high-grade material deteriorates more rapidly than low grade.

On 25 consignments of high-grade material having an average content on despatch of 1.7 per cent pyrethrins the average transit loss was found to be 13.79 per cent or 5.49 lb. of pyrethrins per ton of flowers. On 19 consignments of low-grade material having an average content on despatch of 1.3 to 1.5 per cent pyrethrins the average transit loss was found to be 10.53 per cent or 3.47 lb. of pyrethrins per ton.

Work is now being directed towards ascertaining the causes of deterioration and the application of possible control measures. Little progress can yet be reported but a preliminary experiment conducted in the laboratory revealed no appreciable deterioration in unbaled flowers over periods up to 10 weeks. It appears therefore that flowers baled under pressure may deteriorate more rapidly than unbald flowers. A miniature hydraulic press has been ordered from England in order that comparative experiments may be carried out with flowers baled at various pressures under laboratory conditions.

An experiment using commercial bales has been laid down in which various possible control measures have been applied. The treatments were as follows:—

Bale	Weight	Treatment	Stowage
	<i>lb.</i>		
1	448	Control	Normal
2	448	Treated with "Socophar" Stab- lizer	Normal
3	448	Treated with SO ₂ at 400 p.p.m.	Normal
4	448	Untreated	Cold storage at 35°F.
5	224	Baled at low pressure	Normal
6	448	Untreated	Cold storage at 50° F.
7	448	Treated with SO ₂ at 400 p.p.m.	Normal
8	448	Untreated	Cold storage at 50°F.
9	448	Control	Normal
10	224	Baled at low pressure	Normal
11	448	Treated with "Socophar" Stab- lizer	Normal
12	448	Untreated	Cold storage at 35° F.

Initial analysis was carried out at the time of preparation and samples taken on arrival in the U.S.A. will be returned to the Scott Laboratories by air.

An experiment was conducted to investigate the effect of varied drying conditions upon the pyrethrin content of fresh flowers primarily to ascertain whether flowers could be dried more rapidly using higher temperatures than is the current practice.

Flowers were picked from the S.A.L. plots. Details of the treatments and the results are given in the table below. In each case the figures refer to 1,000 gms. of fresh flowers. Although the results show some variation it is evident that high-temperature drying is deleterious and that if fresh flowers are stored in a closed container before drying the loss in gross pyrethrins is considerable. Flowers after such treatment were badly discoloured and as a result of fermentation processes there was considerable loss of matter.

Treatment	Dry Weight	TOTAL PYRETHRINS	
	<i>gms.</i>	<i>gms.</i>	%
1. Dried in vacuum oven below 40°C.	260.3	3.826	1.47
	231.1	3.515	1.52
2. Dried in miniature hop drier at 55°C.	240.5	3.292	1.37
	261.9	3.923	1.52
3. Sun and shade dried	251.5	3.721	1.48
	245.5	3.509	1.43
4. Dried rapidly at 150°C. in ventilated oven for 1.5–2.5 hours	247.5	2.797	1.13
	249.0	2.837	1.14
	257.6	2.988	1.16
5. Fresh flowers placed in covered container for 7 days followed by shade drying at 25°C. for 5 days	184.0	2.335	1.27
	198.2	2.796	1.41

At the request of the Tanganyika Pyrethrum Board an experiment was conducted to ascertain the rate of depreciation and the preservative effect of "Socophar" on "Florax," "Florax" being a trade name for pyrethrum achenes separated by a patent process from the other parts of the flower.

The experiment was carried out on miniature bales of florax prepared in Tanganyika. The treatments were as follows:—

- (1) Control.
- (2) Treated with 0.035 per cent socophar stabilizer.
- (3) Treated with 0.070 per cent socophar stabilizer.
- (4) Treated with 0.140 per cent socophar stabilizer.

Three sets of miniature bales were prepared as above, one set being analysed at the commencement of the experiment, the second set at six weeks, and the third at three months.

There was no significant difference in the rate of depreciation in any of the treatments.

A table giving the results is given below:—

TREATMENT	INITIAL ANALYSIS			ANALYSIS AFTER 6 WEEKS			ANALYSIS AFTER 3 MONTHS		
	Py1	Py2	Total	Py1	Py2	Total	Py1	Py2	Total
	%	%	%	%	%	%	%	%	%
1. Control	0.99	0.94	1.93	0.91	0.89	1.80	0.91	0.79	1.70
	1.00	0.92	1.92	0.94	0.87	1.81	0.94	0.79	1.73
Mean	1.00	0.93	1.93	0.93	0.88	1.81	0.93	0.79	1.72
2. 0.035 per cent Socophar	1.02	0.96	1.98	0.96	0.83	1.79	0.93	0.79	1.72
	1.00	0.91	1.91	0.94	0.86	1.80	0.94	0.73	1.67
Mean	1.01	0.94	1.95	0.95	0.85	1.80	0.94	0.76	1.70
3. 0.070 per cent Socophar	1.01	0.94	1.95	0.90	0.87	1.77	0.91	0.79	1.70
	1.00	0.91	1.91	0.95	0.86	1.81	0.94	0.75	1.69
Mean	1.01	0.92	1.93	0.93	0.87	1.80	0.93	0.77	1.70
4. 0.140 per cent Socophar	0.98	0.95	1.93	0.92	0.88	1.80	0.91	0.80	1.71
	1.01	0.93	1.94	0.98	0.86	1.84	0.92	0.74	1.66
Mean	1.00	0.94	1.94	0.95	0.87	1.82	0.92	0.77	1.69

In each case the figures refer to dry matter.

This experiment, extended to include also treatment with sulphur dioxide gas and solution of sodium metabi-sulphite, is being repeated on a commercial scale.

An experiment has been commenced in collaboration with Messrs. McLaughlin Gormley King of Minneapolis, U.S.A., designed primarily to check on uniformity of methods but also to investigate depreciation. A quantity of pyrethrum flowers were ground to standard fineness. Six identical samples packed in suitable containers were despatched by air to Minneapolis and six identical samples were retained in Nairobi. It was arranged that the samples should be stored in a refrigerator at about 50°C. and that analysis should be carried out in both places simultaneously on a prearranged day at intervals of one month. Results are to hand for the first two months and are given in the table below:—

DATE OF ANALYSIS	U.S.A.										KENYA							
	SEIL METHOD					AOAC METHOD					AOAC METHOD							
	Py. I		Py. II		Total	Py. I		Py. II		Total	Py. I		Py. II		Total			
	A.R.	Dry	A.R.	Dry	A.R.	A.R.	Dry	A.R.	Dry	A.R.	A.R.	Dry	A.R.	Dry	A.R.			
20-11-50 ..	1.23	1.33	.89	.96	2.12	2.29	1.24	1.34	.93	1.00	2.17	2.34	1.22	1.36	.83	.92	2.05	2.28
19-12-50 ..	1.25	1.35	.82	.89	2.07	2.24	1.24	1.34	.84	.91	2.08	2.25	1.23	1.33	.84	.91	2.07	2.24
16-1-51 ..	1.23	1.33	.83	.90	2.06	2.23	1.24	1.34	.88	.95	2.12	2.29	1.22	1.32	.82	.89	2.04	2.21
13-2-51 ..	1.23	1.34	.83	.91	2.06	2.25	1.26	1.38	.87	.95	2.13	2.33	1.18	1.28	.86	.93	2.04	2.21
MEAN ..		1.33		.91		2.25		1.35		.94		2.29		1.31		.89		2.20
Standard Deviation ..		.0041		.0316		.0264						.0424				.0265		.0529
Coefficient of Variation		.30%		3.47%		1.17%		1.48%		3.97%		1.85%		2.64%		2.97%		2.40%

For the sake of completeness the results of the whole experiment are included in this report, although some of the results were obtained in 1951. There is generally good agreement between the results obtained in U.S.A. and in Kenya by the same method although the American figures tend to be slightly higher. The experiment has shown that identical results can be obtained in different laboratories when precautions are taken to standardize methods.

PYRETHRUM (Agronomy)

A pyrethrum fertilizer of high **repute** in the Belgian Congo was analysed in full and pot culture trials were carried out on its effectiveness in comparison with mixtures of locally available fertilizers having the same composition, on soil from upper Molo and on soil from the Scott Agricultural Laboratories. Neither the Belgian fertilizer nor the local equivalents with which it was compared stimulated pyrethrum growth in either soil. The major difference which showed up in the trial was between the soils, the growth on Scott Agricultural Laboratories soil proving far superior to that on the Molo soil.

Studies of pyrethrum root systems were attempted, but, owing to the hardness of the ground and delicacy of the tissues involved, only partial success was achieved. The main observations were:—

(2) The transverse section of the root zone of a pyrethrum clump is dome-shaped. This conformity may be due to mutual repulsion between the roots of adjacent plants, though this possibility was not tested.

(2) The aerial portions of a pyrethrum plant have high rooting power and this, together with the habit of necrosis of old tissue, leads to the development of clusters of plants at each hill as the plants become old.

(3) Most fine roots are confined to the top 18 inches of soil though a few coarse roots with casings of fine roots find their way, presumably along cracks, to depths of at least 5 feet.

WEEDKILLERS

Further trials of selective weedkillers were hampered by the unsuitability of the seasons. Nevertheless, in a trial on wheat at Nakuru, preparations of sodium 2.4.D and sodium M.C.P.A. were successful, while dilute copper sulphate and dilute sulphuric acid solutions were much less successful in controlling charlock. Laboratory studies of soil and couch grass roots reputed to have originated from a Kikuyu red loam soil near Makuyu which had been treated with a preparation of sodium T.C.A. in connexion with a trial of weed control in sisal, showed that the activity of this weedkiller is quickly destroyed in the soil while submerged couch grass roots, given favourable conditions, are quite capable of reinfesting an area after treatment.

Considerable enterprise in the testing of weedkillers was shown both by farmers and distributors during the year.

INTRODUCTIONS AND ISSUES

The following species were successfully introduced to Scott Agricultural Laboratories from outside territories:—

Artemesia kurramensis, ex India and ex Pakistan.

Artemesia maritima, ex Japan and ex U.S.S.R., both via Australia.

Crotalaria sp., ex Kasama, Northern Rhodesia.

Strophanthus eminii, ex Tabora, Tanganyika Territory.

Heliopsis spp., ex Brazil via U.S.A.

Much of the success in securing these successful establishments is due to the co-operation of Mrs. Nattrass and her staff in the Seed-testing Station, for many of the plants were germinated and received their early nurture in their care.

The following issues were made for external trials, etc.:—

Urena lobata to Eldoret, Nakuru, Kitale, Embu, Meru, Matuga.

Crotalaria juncea to Eldoret, Meru, Matuga.

Aleurites triloba to Eldoret, Nakuru, Matuga.

Musa ensete to Nakuru, Kitale, Meru, Embu, Matuga.

Linum usitatissimum (linseed) to Embu.

Nicotina tobaccum (high nicotine) to Njoro.

Pennisetum purpureum (hairless type) to Tambach, Kapsabet, Kabarnet, Kapenguria, Matuga, Nyeri, Kisumu, Embu, Thika, Machakos, Jacaranda.

EDWIN BELLIS,

Soil Chemist.

ANNUAL REPORT OF THE SENIOR PLANT BREEDER, 1950

The Season—Wheat General

The season started well with a useful total of rain in March followed by satisfactory rains in April. May and June were below average, the former month being particularly low in rain with only four days recording over 0.1 in. and one day recording over 0.2 in. July's rainfall was slightly over average, but again August showed a below average figure. The year's rainfall on the Plant Breeding Station was for the third year in succession below average, 28.29 in. being recorded. Rainfall on this station was as follows:—

Month	1950 inches	21 Years Average inches
January	0.97	0.83
February	Nil	1.22
March	2.60	2.67
April	4.60	4.37
May	1.91	4.03
June	2.48	3.69
July	5.13	4.91
August	4.06	4.89
September	2.44	2.35
October	2.04	1.74
November	1.19	2.47
December	0.87	1.75
	28.29	34.92

In general this has been a good wheat year in spite of the early drought and poor distribution of the rainfall. Early sown crops received a set-back due to the dry conditions in May but picked up later to give reasonable yields whilst wheat sown in the middle of the season grew well throughout and ripened into heavy yielding crops. The acreage sown to wheat in Kenya in 1950 was 264,404 acres, a record and 17 per cent over the previous season, and has produced a crop of 1,421,744 sacks (4,802,480 bushels). In the Northern Province of Tanganyika also a record crop of 80,000 sacks (267,000 bushels)* from 11,000 acres has been produced whilst 3,000 acres were seeded to wheat in the Southern Highlands areas of the Territory as an experiment to determine the potentialities of the area for wheat growing.

It is of interest to note that upwards of 70 per cent of the acreage sown to wheat in Kenya during the year was seeded with varieties produced by this station. The remainder is accounted for by importations, chiefly the South American variety, Sabanero, and the Canadian variety Regent, which have been introduced by the Plant Breeding Services and released to farmers for general cultivation after trial over a number of years.

REVIEW OF MAIN WHEAT VARIETIES GROWN

The main varieties of wheat grown in the Colony during the season were Cross 294†, chiefly 294.M (32 per cent); Cross 318†, chiefly 318. AJ.4.A.1. (12 per cent); Equator (10½ per cent); Sabanero (10 per cent) and Regent (9½ per cent); the figures in brackets give the approximate percentage of the total acreage sown to each. As forecast in my 1949 Report Cross 294 has rapidly gained favour with growers on account of its good straw, disease resistance and yielding powers over

* Over 90 per cent of the 1950 wheat crop of the Northern Province of Tanganyika was produced from Kenya-bred hybrids.

†The following approximate percentages of the total acreage were sown to the component varieties of these two crosses: 294.M.7.C.6.A and 294.B.2.A.3 combined, 31 per cent; 294.M.7.C.1.C (Kenya Settler), 1 per cent; 318.AJ.4.A.1, 9½ per cent, 318.O.3.B.2 (Kenya Ploughman), 2½ per cent.

a wide range of soils and altitudes and now ranks easily the most popular variety, accounting for roughly one-third of the Colony's wheat acreage. 294.M is of "filler class" quality only and further crosses have been made to try and improve the quality of this variety whilst retaining its valuable agronomic characters. Unfortunately, 294.M has been found susceptible in seedling tests to K9, the latest physiologic form of black stem rust to be isolated in East Africa, although it has not been damaged in the field.

318.AJ.4.A.1, released to farmers in 1949, occupies a high place in order of popularity on account of its good straw, yielding powers and ability to resist yellow ear rust, *Puccinia glumarum*, at the higher altitudes. Since it is one of the few varieties resistant in seedling tests to K9, and is also resistant to all the earlier forms, it is probable that the acreage sown to this variety will increase next season. The grain is of "filler class" quality only and is unfortunately characterized by excessive stability in relation to its general strength. Crosses have been made in an attempt to counteract this undesirable characteristic.

Equator and Sabanero are old established varieties still grown on an appreciable scale, the former due to its resistance to yellow ear rust in the highest wheat-growing areas, the latter since it can be relied upon to give a reasonable, if not high, yield over a wide range of conditions and soils.

Regent, a hard red Canadian spring wheat, which was badly attacked as low as 7,000 feet by yellow ear rust last season as explained more fully in the 1949 Report, has, as expected, declined severely in popularity and has fallen from first place that year, with some 30 per cent of the total acreage sown to it, to fifth place, or under 10 per cent this season. The grain is of excellent milling quality and crosses have been made to combine this characteristic with better resistance to rust.

117.A, a few years back the most popular variety with growers, declined to eighth place, with only about $2\frac{1}{4}$ per cent of the total acreage sown to it, and it has now been replaced by newer, stronger strawed, and better yielding, hybrids. It is susceptible in seedling tests to K8 and to the new form K9 of stem rust. 117.A has also been attacked in the field but no appreciable damage to this variety on a field scale has yet occurred.

RUST AND OTHER DISEASES

More black stem rust, *Puccinia graminis tritici*, was seen during the season than usual. Equator, in particular, was quite severely attacked in the Molo-Mau and higher areas round Ol Kalou and some fields seriously reduced in yield in consequence. The most prevalent rust form occurring both in Kenya and in the Northern Province of Tanganyika was found on survey to be K9 with the old forms K1 and K5 also occurring on a number of occasions. None of the other forms was found. The earlier form, K8, which appeared in 1948 firstly in the Oldeani and Ngare Nairobi districts of the Northern Province of Tanganyika, and subsequently in the breeding cages at the Scott Agricultural Laboratories in the same year, has not again been found either in 1949 or the year under review.

Leaf rust, *Puccinia triticina*, was little in evidence, but yellow ear rust, *Puccinia glumarum*, was more widespread and the attacks more severe than usual over altitudes of 7,000 feet due, probably, to the abnormally cold and wet conditions experienced during July and August.

Take-all, *Ophiobolus graminis*, was present in the higher areas particularly over 8,000 feet and yields were reduced in fields which had been growing wheat too often without rotation. Take-all is essentially a disease of the high areas and does not occur to any degree below 7,000 feet. It can occur on land newly broken from grass but usually is a warning sign that wheat and barley have been grown on the same piece of land too often without proper rotation.

Glume blotch, *Septoria nodorum*, and *Fusarium* root rot were seen but caused no appreciable damage. One field of 261.R was found to be badly affected by scab, *Fusarium graminearum*, a disease not common in Kenya.

PHYSIOLOGICAL FORMS OF BLACK STEM RUST—APPEARANCE OF A NEW FORM

As forecast in my 1949 Annual Report, when 291.J.1.1 rusted for the first time, the presence of a new physiological form of black stem rust has now been established. It has been found both in Kenya and in the Northern Province of Tanganyika. This now makes the ninth form of black stem rust to be identified in the Colony up to date. Only 318.AJ.4.A.1, among the commonly grown established varieties, and 360.H and 184.P.2.A.1.A among the new releases, show resistance in seedling tests; all the remainder including 294.M, Equator, Sabanero, Regent, and 117.A are susceptible. It is interesting to record that in 1928 two stem rust forms were identified in Kenya designated K1 and K2. A third form, K3, was isolated in 1930, K4 in 1931, K5 in 1936, K6 in 1940, K7 in 1943, K8 in 1948 and K9 in the present season.

The arrival of yet another physiological form of stem rust, to which most of the commonly grown wheats are susceptible, considerably complicates the task of recommending varieties for growing. Inevitably varieties must be seeded which, though satisfactory in other respects, are susceptible to this new rust form and a certain amount of risk from stem rust damage must be accepted. Advice has, accordingly, been issued in the local Press giving the rust reactions of the commonly grown wheats and advising on varieties to be grown in the coming season with the rust background in mind.

Form K9 shows susceptible reactions on the testers, 112, Reliance, 58F and 117.A; resistant reactions on Kenya Governor and Einkorn; and a border line reaction on B.256.G, which serves to distinguish it from the older forms.

Release of New Wheats

Six new wheats were released to farmers from Departmental control for sowing in 1951. Plans had already been made for the release of these varieties when K9 made its appearance. Seedling tests showed that two, 360.H and 184.P.2.A.1.A, were resistant and the remainder susceptible. As it was considered that these latter varieties were likely to be of value to farmers and also in view of the need to find a substitute for Equator in the higher areas it was decided to proceed with their release.

WHEAT No. 360.H

A selection out of the cross 294.M.7.C.6.C $\times$ 184.P.2.A.1.E, bred at Njoro.

360.H is a beardless, white-chaffed, white-grained wheat possessing fair straw strength and medium-length maturity roughly equal to 294.M and taking approximately 5½–5¾ months at Njoro, 7,100 feet. It has full resistance in seedling tests to the nine forms of black stem rust occurring in the Colony, possesses good resistance to orange leaf rust and has shown resistance to yellow ear rust up to 8,500 feet in Kenya.

This wheat is similar to 294.M in appearance and straw strength and is slightly superior in yield. It has done well in large-scale trials in the Solai, Subukia, Rongai, Njoro, Ol Kalou, Plateau and Endebess areas of the Colony and should be suited to all areas from 6,000 to 8,500 feet approximately in Kenya, and 5,500 feet upwards in the Northern Province of Tanganyika, having a growing season of five to six months' duration.

The grain is of moderate baking quality.

WHEAT No. 337.BE.2.F.2

A selection of the cross 223.F.1.A.3 $\times$ 291.J.1.B.1, bred at Njoro.

337 is a beardless, white-chaffed, white-grained wheat possessing good straw strength and quick maturity taking approximately 5½ months at 8,500 feet and 6 months at 9,000 feet in Kenya. It has full resistance to the first eight physiologic forms of black stem rust occurring in the Colony but shows susceptibility in seedling tests to the newest and ninth form. It has been slightly attacked in the field but not damaged. It possesses good resistance to orange leaf rust and has shown resistance to yellow ear rust up to 9,500 feet in Kenya.

337 has done well in large-scale trials in the Molo-Mau Summit, Ol Kalou, Upper Gilgil and Burnt Forest areas of the Colony and should be suitable to all areas in Kenya from 7,500 feet to 9,500 feet, having a growing season of five to six months' duration. The variety tends to shed when ripe.

The grain is of poor to moderate baking quality.

WHEAT No. 338.AA.1.A.2

A selection out of the cross 192.Q.2.A.L × Australian 27/2.2.1.5, bred at Njoro.

338 is a beardless, white-chaffed, white-grained wheat of good straw strength. It is of medium-length maturity taking approximately five months at 6,000 feet in Kenya. It has full resistance in seedling tests to the first eight physiologic forms of black stem rust and shows susceptibility to K9. It has not been attacked by stem rust in the field. It possesses resistance to orange leaf rust and has shown resistance to yellow rust up to 7,000 feet in Kenya.

338 has done quite well on a field scale in the Machakos and Endebess areas of Kenya and should be suited to all areas of the Colony from 5,000 feet to 7,000 feet, having a growing season of five months' duration.

The grain is of good baking quality.

WHEAT No. 184.P.2.A.1.A

A selection out of the cross Reliance × 296.B.6.Y.(L), bred at Njoro.

184 is a bearded, white-chaffed, red-grained wheat. The straw is tall and weakish. It is of medium-length maturity taking approximately 5½ months at 6,500 feet in Kenya. It has full resistance in seedling tests to all nine physiologic forms of black stem rust, possesses resistance to orange leaf rust and is resistant to yellow rust up to 6,500 feet in Kenya.

184 has done well on a field scale in the Menengai and Endebess areas of Kenya and should be suited to all areas of the Colony from 5,000 ft. to 6,500 ft., having a growing season of five months' duration.

The grain is of good baking quality.

WHEAT No. 350.AD.9.C.2

A selection out of the cross 223.F.1.A.3 × 294.M.7.C.8, bred at Njoro.

350 is a beardless, white-chaffed, white-grained wheat of fair straw strength, and quick maturity taking approximately 5½ months at 8,500 ft. and six months at 9,000 ft. in Kenya. It has full resistance to the first eight physiologic forms of black stem rust and shows susceptibility to K9 in seedling tests. It possesses resistance to orange leaf rust and is resistant to yellow ear rust up to approximately 8,500 ft. in Kenya.

350 has done well on a field scale in the Molo and Mau Narok areas of Kenya and should be suited to all areas of the Colony from 7,500 ft. to 9,000 ft., having a growing season of 5½–6 months' duration. This variety tends to shed when ripe.

The grain is of poor to moderate baking quality.

WHEAT No. 341.F.2.D.1

A selection out of the cross 279.I.5.F.2 × Eureka G.2503, bred at Njoro.

341 is a beardless, white-chaffed, white-grained wheat of good straw strength, moderate quality and quick maturity taking approximately six months at 9,000 ft. in Kenya. It has full resistance to the first seven physiologic forms of black stem rust and is susceptible in seedling tests to K8 and K9. 341 has been slightly attacked by stem rust in the field but not damaged. It possesses resistance to orange leaf rust and is resistant to yellow ear rust up to 9,000 ft. in Kenya.

341 has done well on a field scale in the Molo and Mau Narok areas of Kenya and should be suited to all areas of the Colony from 7,500 ft. to 9,000 ft., having a growing season of six months' duration.

In the case of all the above varieties showing seedling susceptibility farmers have been warned of this fact and advised to proceed carefully with these varieties until more is known of their stem rust reactions in the field.

New Wheats Under Multiplication With Farmers

Of the new wheats still under multiplication with farmers, and described in the 1949 Report, 338.AC.2.E.1 has been abandoned since its yield and baking quality was found inferior to the sister strain AA.1.A.2. 294.H.2.A.1 and the bearded 291 selection, J.1.1.1.1.1 will not be released for the time being, if at all, since they appear to offer no advantages over the strains of these crosses already being grown. 355.AZ.1 and 321.BT.1.B.1 have been found susceptible in seedling tests to both K8 and K9 and will be kept under departmental control for a further period to test their stem rust reactions in the field. Neither variety has rusted in the field and 321 is already in an advanced stage of multiplication for possible release to the farming community.

Both 351.AS.1.B.2 (117.A × Regent) and the Durum wheat Carleton, C.I.12064, are resistant in seedling tests to all forms including K9 and multiplication of these varieties will be continued.

Newthatch, C.I.12318, has been found susceptible in seedling tests to K6, K7 and K9 and, in view of this, coupled with its low yielding ability in Kenya, its further multiplication may have to be abandoned. It has, however, as mentioned in the 1949 Report, been used in crosses designed to incorporate its valuable property of distensibility into Kenya-bred hybrids.

Of the four rust free selections from D.C. × Ceres, two only R.64 and R.46, are being carried into large-scale tests for possible release to farmers.

Wheat Breeding at the Plant Breeding Station, 7,100 ft., and the Rongai Sub-station, 6,000 ft.

IMPORTATIONS

The following trials of 1948, 1949 and 1950 importations were carried out at the Plant Breeding Station, Njoro, unless otherwise stated.

1948 Importations

From Professor Waterhouse, Sydney, New South Wales.—The two wheats which were carried on from the original 13 imported, W1404 (Dundee × Kenya 745) and W1534 (Geeralying × Kenya 745), remained free of rust but were quite badly affected by scab and gave grain of low bushel weight.

From the Central Experimental Farm, Ottawa, Canada.—Both Cascade C.A.N. 3593 and Saunders C.A.N. 3516 were badly attacked by *P. glumarum* on the foliage which in Saunders infected 50 per cent of the florets. In addition, Saunders was infected by blotch, *Septoria nodorum*, and Cascade by stem rust with pustules of the "S" type. Both gave poor and shrivelled grain.

From the Department of Agriculture, Victoria, Australia.—Diadem, although having a general infection of stem rust with pustules of the R/S type, possesses good short straw and may be of use as a possible parent in crosses for this reason.

From Dr. C. H. Goulden, Winnipeg, Manitoba, Canada.—Redman, C.A.N. 3633, remained free of stem rust but was badly attacked by yellow rust, about 80 per cent of the florets being infected.

From the State of Arizona, U.S.A.—Marfed, C.I. 11919, proved to have good straw but was badly attacked by stem rust of the R/S type. The foliage was also infected by *P. glumarum* which, however, did not attack the ears. This wheat may also be of use as a parent on account of its short straw.

From the Economic Botanist, New Delhi, India.—The five durums out of the original 18 imported proved rather susceptible to ear rust, although the grain of all bushelled over 60 lb. All except one had a few minute pustules of stem rust. They will again be the subject of test during the coming season at lower altitudes.

All these varieties will be tested for quality before any decision is made regarding their future.

1949 Importations

From S. Rhodesia.—Granadero Klein and Pusa 52.AL.5 proved the best of the eight varieties out of the original 61 importations carried on for further test. The remainder produced pinched or shrivelled grains. Both were attacked by *P. glumarum* at Molo, 9,300 ft., about 30 per cent of the florets being infected.

C39, 237 and 294, although poor at Njoro, did much better at Molo and were little infected by *P. glumarum*, only 5–10 per cent of the florets being attacked. All were attacked in varying degrees by stem rust. Granadero Klein, although of poor general strength, shows very distensible characteristics and may be of use as a parent for this reason.

From Potchefstroom, S. Africa.—Three of the six *T. vulgare* × *T. Timopheevi* crosses originally imported were under test. Of these, 466–4.M.M.3 and 361.M.4.1 will be carried on for further trials. Both remained free of stem rust at Njoro but 361 was quite badly attacked by leaf rust, *P. triticina*. At Molo both remained completely free of *P. glumarum*. 466, on test, showed poor baking strength, whilst 361 proved to be a strong wheat. Both showed stable characteristics.

The remaining selection, C 17-1-1, which showed promise last season, was badly attacked by *P. glumarum* both at Njoro and Molo and the foliage killed. It remained free of stem rust.

From the Ministry of Agriculture, Orman, Egypt.—Mukhtar and Giza, promoted to further trial from last season, proved disappointing at Njoro and Molo. Mukhtar remained free of stem rust but Giza was slightly attacked. Both were attacked by scab, *Fusarium graminearum*, and gave badly pinched grain of low bushel weight. Neither was appreciably attacked by *P. glumarum*. They will be tried at a lower altitude during the coming season.

From the Dominion Laboratory of Cereal Breeding, Manitoba, Canada.—Of the 11 wheats listed in the 1949 Report, three, Chinese × (Chinese × *A. elongatum*), Perennial 400 and Triticale R.L.2388 failed to set in 1949. The remainder were carried on to 1950; some (R.L.2150 and 2183) remained free of stem rust, some (R.L.2200, 1742, 3047 and 3048) suffered slight infection, and others (R.L.2327.5, 2477 and 2564) were more severely infected. At Molo R.L. Nos. 2150, 2200 and 1742 were less attacked by *P. glumarum* and produced plumper grain than the remainder. The varieties so far tested for baking quality range from stable to balanced characteristics; Hope × Timstein, R.L.2477, in particular, although stable, shows great general strength. All will be carried on for further test.

From Estaçao de Melhoramento de Plantas, Elvas, Portugal.—Of the large number of importations from the above station made in 1949 three, Argelino 10990, Russo 8683 and Santa Marta 2286, were carried on for trial in the current season. The first two were attacked by stem rust with pustules of the R/S type but stood well, produced reasonably plump grain and will be retained for further testing. S. Marta was badly attacked by stem rust, producing pustules of the "S" type and will be discarded.

All are Durum wheats and a satisfactory wheat of this class is required to satisfy the demands for atta made by the Indian trade.

1950 Importations

The following wheats were on trial for the first time:—

From the Dominion Cerealist, Ottawa, Canada.—Mida × Cadet C.A.N. 3668 and Hope × Timstein C.A.N. 3751. The first was slightly attacked by stem rust, whilst the second remained free except for one plant which rusted. Both will be carried over to further trials in 1951.

From the Waite Agricultural Research Institute, Adelaide, Australia.—Glenwari, Nabawa × (Riverina × Hope)—strain 38-356, Dirk 48 and Javelin

48-RP-31. All suffered in varying degrees from *P. glumarum* on the foliage and, in addition, Glenwari and Dirk were slightly attacked by stem rust of the "R" type and by glume blotch. Javelin had weak straw and lodged.

From the Department of Agriculture, Perth, W. Australia.—Wongoondy (Eureka × Bungulla) and Dowerin (Sword × Kenya C 6041). Both grew very poorly: Wongoondy was badly attacked by yellow rust both on the foliage and in the ears, having 100 per cent of the florets infected.

From the United States Department of Agriculture, Washington.—Red Egyptian, Premier × Bobin²- Gaza II-39-2, Klein Titan, Rio Negro, II-39-46 (Minn 2776), Timstein, Newthatch × Timstein II-42-22, and Surpresa. The first three were badly attacked by stem rust, the next three had a slighter infection, whilst Newthatch × Timstein remained free. Surpresa did not germinate. These varieties will be further tried out during the coming season.

From Dr. E. C. Stakman, Minnesota, U.S.A.—The leaf rust differentials Brevit C.I.3778, Loros C.I.3779, Carina C.I.3756, Webster C.I.3780, Thew C.I.5002, Mediterranean C.I.3332, Malakof C.I.4898, Hussar C.I.4843, Democrat C.I.3384. The first three were badly attacked by leaf rust, the remainder suffered only very slight infection or remained completely free. Democrat refused to come into ear and produced no grain.

CAGE MATERIAL

Selection was made in the crosses 372–392, listed in the 1948 Annual Report, which have now advanced to F.2. The *Triticum Timococcum* × Marquis, Regent and Newthatch back-crosses were again back-crossed to Regent and 318.AJ.4.A.1; control heads emasculated and uncrossed set only a few seeds.

Crosses 363–367 have now advanced to F.4 and selected material which has reached apparent fixity will be promoted to the multiplication plots in 1951.

The following new crosses were made:—

1949—

- Cross 397—377 × Regent (291.J.1.I.1 × Regent²).
- Cross 398—387 × Kenya Governor (291.J.1.I.1 × K.G.²).
- Cross 399—388 × 294.AI.5.G.2 (291.J.1.I.1 × 294.AI.5.G.2²).
- Cross 400—389 × 261.R.7.C.1.B (291.J.1.I.1 × 261.R.7.C.1.B²).
- Cross 401—390 × 261.S.10.C.2.D (291.J.1.I.1 × 261.S.10.G.2.D²).
- Cross 402—384 × 318.O.3.B.2 (Equator II × 318.O.3.B.2²).
- Cross 403—385 × 318.AJ.4.A.1 (Equator II × 318.AJ.4.A.1²).

1950—

- Cross 404—360.H × 318.AJ.4.A.1,
- Cross 405—360.H × Newthatch.
- Cross 406—360.H × Regent.
- Cross 407—360.H × 350.AD.9.C.2.
- Cross 408—360.H × 338.AA.1.A.2.
- Cross 409—337.V.1.B.1 × Regent.
- Cross 410—337.V.1.B.1 × 341.F.2.D.2.
- Cross 411—184.P.2.A.1.F × Reward.
- Cross 412—184.P.2.A.1.F × Australian 26.A.
- Cross 413—337.Y.4.A.4 × Regent.
- Cross 414—350.AD.9.C.2 × 341.F.2.D.2.
- Cross 415—350.AD.9.C.2 × Regent.
- Cross 416—350.AD.9.C.2 × Regent.
- Cross 417—350.AD.9.C.2 × 360.H.
- Cross 418—Reward × 337.BE.2.F.2.
- Cross 419—Reward × 261.R.7.C.1.B.
- Cross 420—Reward × 294.M.7.C.6.A.
- Cross 421—Reward × 261.R.7.C.1.B.
- Cross 422—Reward × 184.P.2.A.1.F.
- Cross 423—Reward × 337.BE.2.F.2.

- Cross 424—Reward $\times$ 338.AA.1.A.2.
 Cross 425—337.BE.2.F.2. $\times$ Regent.
 Cross 426—337.BE.2.F.2 $\times$ Reward.
 Cross 427—D.C.Ceres R.46 $\times$ 337.BE.2.F.2.
 Cross 428—337.BE.2.F.2 $\times$ Regent.
 Cross 429—291.J.1.B.1 $\times$ 337.BE.2.F.2.
 Cross 430—338.AA.1.A.2 $\times$ 294.M.7.C.6.A.
 Cross 431—338.AA.1.A.2 $\times$ Reward.
 Cross 432—Australian 26.A $\times$ 184.P.2.A.1.F.
 Cross 433—Australian 26.A $\times$ 261.R.7.C.1.B.
 Cross 434—Newthatch $\times$ 294.M.7.C.6.A.
 Cross 435—Newthatch $\times$ 294.M.7.C.6.C.
 Cross 436—337.Y.4.A.1 $\times$ Regent.
 Cross 437—337.Y.4.A.4 $\times$ D.C.Ceres R.46.
 Cross 438—337.Y.4.A.1 $\times$ D.C.Ceres R.46.
 Cross 439—294.M.7.C.6.A $\times$ Newthatch.
 Cross 440—294.M.7.C.6.A $\times$ Regent.
 Cross 441—294.M.7.C.6.A $\times$ 338.AA.1.A.2.
 Cross 442—294.M.7.C.6.A $\times$ Reward.
 Cross 443—261.R.7.C.1.B $\times$ Australian 26.A.
 Cross 444—261.R.7.C.1.B $\times$ Reward.
 Cross 445—261.R.7.C.1.B $\times$ Reward.
 Cross 446—D.C.Ceres R.46 $\times$ 337.Y.4.A.1.
 Cross 447—Unknown $\times$ D.C.Ceres 721.
 Cross 448—341.F.2.D.2 $\times$ Regent.
 Cross 449—337.BE.2.F.2 $\times$ 360.H.
 Cross 450—337.BE.2.F.2 $\times$ 360.H.
 Cross 451—184.P.2.A.1.F $\times$ 360.H.
 Cross 452—184.P.2.A.1.F $\times$ 360.H.
 Cross 453—Newthatch $\times$ D.C.Ceres R.46.
 Cross 454—337.V.1.B.1 $\times$ D.C.Ceres R.46.
 Cross 455—337.Y.4.A.1 $\times$ D.C.Ceres R.46.
 Cross 456—337.Y.4.A.4 $\times$ D.C.Ceres R.46.
 Cross 457—Newthatch $\times$ D.C.Ceres R.46.
 Cross 458—337.V.1.B.1 $\times$ D.C.Ceres R.46.
 Cross 459—Kenya Governor $\times$ Cross 398 (291.J.1.I.1 $\times$ K.G.²).
 Cross 460—Cross 398 $\times$ K.G. (291.J.1.I.1 $\times$ K.G.²).
 Cross 461—Cross 397 $\times$ Regent (291.J.1.I.1 $\times$ Regent²).
 Cross 462—Cross 400 $\times$ 261.R.7.C.1.B (291.J.1.I.1 $\times$ 261.R.7.C.1.B²).
 Cross 463—Newthatch $\times$ Cross 373 (Newthatch² $\times$ 117.A).
 Cross 464—393.A $\times$ Regent (Triticum Timococcum $\times$ Marquis $\times$ Regent²).
 Cross 465—393.A $\times$ 318.AJ.4.A.1 (Triticum Timococcum $\times$ Marquis $\times$ Regent $\times$ 318.AJ.4.A.1).
 Cross 466—393.B $\times$ Regent (as 464).
 Cross 467—393.B $\times$ 318.AJ.4.A.1 (as 465).
 Cross 468—393.C $\times$ Regent (as 464).
 Cross 469—393.D $\times$ 318.AJ.4.A.1 (as 465).
 Cross 470—393.E $\times$ 318.AJ.4.A.1 (as 465).
 Cross 471—393.E $\times$ Regent (as 464).
 Cross 472—Cross 403 $\times$ 360.H (Equator II $\times$ 318.AJ.4.A.1²).
 Cross 473—Cross 402 $\times$ 360.H (Equator II $\times$ 318.O.3.B.2²).

The above list contains a number of reciprocal and repeat crosses. The total number of seeds harvested in crosses 404–463 was 4721 out of a possible total of 6761 = 69.83 per cent.

Apart from the straight crosses the programme of back-crossing started in 1948 was continued. This has as its object the transference from one parent of a single character to an otherwise desirable variety which lacks it.

WHEATS UNDER MULTIPLICATION

Selected segregates from the crosses 354 (Warigo $\times$ Sterling), 357 (184.P.2.A.1.E. $\times$ 294.AN.4.A.1), 359 (291.J.1.I.1 $\times$ 184.P.2.A.1.E) and 360 (294.M.7.C.6.C $\times$ 184.P.2.A.1.E) were further multiplied and tested for yielding ability in the yield trials. It has already been mentioned earlier in this report that one strain of Cross 360, 360.H, has been released to farmers during the season under review.

Cross 354 is characterized by distensibility, an uncommon property in Kenya wheats, and it should be of value on this account. The remaining crosses, although of good agronomic qualities, unfortunately possess marked stability which renders them of less value to the miller and baker.

YIELDS OF NEW WHEATS UNDER TRIAL

The following table gives yields of some of the newer hybrids at Njoro, 7,100 ft., and at Rongai, 6,000 ft., taken from the yield trials. Yields are all low due to drought; nevertheless, it is interesting to note that the newly-released 360.H heads the list at Njoro and has also done well at Rongai.

Variety	YIELD (Bags of 200 lb. net per acre)	
	Njoro	Rongai
360.H	8.70	4.70
360.H.3	7.95	4.61
360.F.8.D.3	7.60	—
360.E.13.C.7	6.65	—
350.AD.9.C.2	6.47	—
117.A (Sel.)	6.37	3.59
Ceres R.64	5.91	—
Ceres R.46	5.50	—
359.AV.1.C.2	5.33	—
360.E.2.C.3	5.11	—
359.AA.8.B.8	4.89	—
357.AB.1.D.1	4.78	—
337.BE.2.F.2	4.55	—
Cascade	4.48	—
359.AA.8.B.1	4.41	—
360.E.13.C.6	4.35	1.98
357.AB.1.D.7	3.93	—
359.P.5.A.2	3.92	—
359.AV.1.B.2	3.63	—
337.V.3.B.1	3.57	—
357.AF.2.A.1	3.52	—
360.E.2.D.1	3.46	—
359.P.4.B.1	3.21	—
357.AB.1.D.10	3.20	—
359.P.4.B.3	2.94	—
261.E	—	6.17
261.V	—	4.81
261.G	—	4.80
338.AA.1.A.2	—	4.79
338.AC.2.E.1	—	4.71
261.D	—	4.67
261.F	—	4.57
261.R	—	4.47
184.P.2.A.1.A	—	3.82
351.AS.1.B.2	—	3.76
Carleton	—	1.66
L.D.128	—	1.61

Significant Differences—

P.05 =	0.73	0.65
P.01 =	0.97	0.87

Wheat Breeding at the High and Low Altitude Sub-stations

SCOTT AGRICULTURAL LABORATORIES, 5,700 Ft.

No crosses were grown at this station during the year and the small amount of droughted material harvested from crosses 356 and 358 in 1949 was grown at Njoro in 1950. Promising segregates are to be multiplied in 1951 for yield trials and field tests.

MOLO SUB-STATION, 9,300 Ft., AND OL JORO OROK, 7,800 Ft.

The aim of the high altitude breeding work is to produce varieties suited to the cooler and longer season conditions which obtain in these areas. Such varieties must possess resistance to yellow ear rust, *P. glumarum*, if they are to be successful. Virtually the mainstay of the highest wheat-growing areas has been the variety Equator on account of its resistance to this rust species. In other respects it is unsatisfactory in that it is susceptible to stem rust, and was damaged from this cause during the present season as earlier discussed; further, it has weak straw, is of medium yield and poor baking quality. As a result of this work three varieties 337.BE.2.F.2, 341.F.2.D.1 and 350.AD.9.C.2 possessing resistance to yellow ear rust and of higher yielding ability have already been released to farmers.

Results of the seasons yield trials are:—

Variety	YIELD (Bags of 200 lb. net per acre)	
	Molo	Ol Joro Orok
337.BE.2.F.2	6.54	9.88
360.H	6.26	10.09
318.AJ.4.A.1	6.12	—
350.AD.9.B.1	5.37	—
350.AJ.3.A.1	5.15	—
350.AJ.3.C.1	4.85	—
350.AJ.3.C.2	4.70	—
Equator II	4.68	—
350.AR.4.B.1	3.77	—
337.V.2.B.3	3.75	—
350.C.2.B.2	3.53	—
337.AA.1.A.3	3.19	—
350.AE.4.A.1	3.13	—
337.C.2.A.2	3.03	—
337.C.2.A.3	2.73	—
340.Y.6.B.3	2.30	—
337.V.3.B.1	—	10.88
341.F.2.D.1	—	8.98
350.AD.9.C.2	—	8.95
341.F.2.D.2	—	8.51
318.O.3.B.2	—	8.29
Ceres R.64	—	7.19
337.V.1.B.1	—	7.02
Ceres R.46	—	6.72
Ceres Control	—	6.54
337.AA.1.A.3	—	6.08
Significant Differences—		
P.05 =	0.56	1.39
P.01 =	0.75	1.85

Baking Quality and Fermentation Tests

The Kenya millers, Messrs. Unga, Ltd., Nairobi, have now engaged their own cereal chemist and samples of all advanced hybrids undergoing multiplication for possible release to farmers are tested by courtesy of Messrs. Unga in their Nairobi laboratory. This is a great step forward since problems connected with

baking quality can now be discussed on the spot. Had this most valuable facility been available earlier not only would it have been of the greatest assistance in the production of better quality wheats but it might well have prevented the excessive stability of most Kenya-bred hybrids.

Pelschenke wholemeal fermentation tests are also carried out as a routine measure on all new hybrids. This test serves as a guide to quality in the early stages of selection when material is very limited in quantity.

Barley

It has not been a good season for malting barley on account of lack of rain which produced hard and steely samples instead of the soft and mealy cuts required by the malster. Research, a two-row variety received from the State Research Farm, Victoria, Australia, and released to farmers from Departmental control in 1948, continued to yield well and to prove resistant to yellow ear rust as high as 9,000 ft. This variety is more popular with farmers than its parent Prior on account of its stronger straw.

In the lower areas below 7,000 ft. Glacier from the U.S.A. and Mariout from Canada, both six-row feed barleys, again proved satisfactory in straw strength and yield. There seems little to choose between the varieties for this purpose.

YIELD TRIALS

Results of the barley yield trials at Njoro, Rongai, Molo and Ol Joro Orok for the season are given below:—

Variety	YIELD (Bags of 180 lb. net per acre)			
	Njoro	Rongai	Molo	Ol Joro Orok
Ymer	9.14	—	—	—
Compana	8.40	4.22	—	—
Hannchen	8.05	3.97	—	—
Trebi	7.93	2.36	—	—
Glacier	7.85	5.95	—	—
Prior	7.44	5.36	8.05	—
Tregal	7.43	3.85	—	—
Sanalta	5.38	2.56	—	—
Vantage	—	3.11	—	—
Research	—	—	10.56	6.99
Prefect	—	—	10.39	—
Spratt Archer	—	—	9.46	3.58
C. R. Dense	—	—	8.67	—
Spratt	—	—	7.58	—
Maltworthy	—	—	7.42	—
Plumage	—	—	5.03	—
Plumage Archer	—	—	4.74	1.92
Ray	—	—	—	6.93
Golden Archer	—	—	—	5.80
Colville	—	—	—	4.80
Abed Kenia	—	—	—	4.74
Significant Differences—	1.29	0.88	1.97	1.91
P.05 =	1.73	1.18	2.66	2.57
P.01 =				

In spite of low yields due to drought the Australian two-row barley, Research, has again done well and can now be said with Prior to be established in Kenya both for feed and malting purposes on account of its adaptability, good yielding

powers and its ability to produce plump, mealy samples of grain if conditions are right. Research has given a yield over a three-year period, averaged over the three stations, Njoro, Rongai and Ol Joro Orok, of 11.1 bags per acre.

The Danish barley, Ymer, heads the list at Njoro this season but this is its first year under trial in Kenya and further tests over a number of seasons will be necessary to determine whether it maintains its initial promise. The American varieties, Compana, Hannchen and Trebi, have also done well at Njoro, but again they are on trial for the first time and it is early yet to do more than indicate their possibilities. All these varieties, together with the majority of the American barley introductions mentioned in the 1949 Report, are under increase for further larger scale tests during the coming season.

Abed Kenia, which has shown promise in initial tests at Njoro and Ol Joro Orok, is being multiplied up for further tests next year. It has good straw, stands well and has yielded second only to Research, averaging 10.5 bags per acre over the three-year period at the same centres.

Spratt Archer has out-yielded Plumage Archer, both at Molo, where a barley yield trial was started up for the first time this season, and at Ol Joro Orok. However, the yields of the English barleys are not in general as high as those of Australian origin and they are grown only on a limited scale in Kenya.

Mention should be made of the new six-row variety Prefect from the Plant Breeding Institute, Cambridge. This barley did badly at Njoro in initial tests and doubt was expressed about its future in this country. It put up a much better performance at higher altitudes and the yield figures at Molo this season well bear this out. Prefect will again be under test in 1951 and shows promise of being a successful feed variety for the higher barley-growing areas.

OBSERVATION PLOTS

In the observation plots at Njoro the American variety, Peatland, proved outstanding, remained free of disease and stood well. Other varieties of promise were Chevron, Vantage, Trebi, Tregal, Plush, Wisconsin and Velvon, all of which remained free of *P. glumarum*. Hannchen, Compana, Montcalm, Mars, Velvet, Prospect and Rex were badly attacked by *P. glumarum* on the leaves, and in the ears in some cases, the foliage being completely killed in the last-named variety. Titan, Newall and Regal proved to be the poorest of these introductions at Njoro.

At Ol Joro Orok, Hannchen showed up well with Trebi, Chevron, Peatland and Vantage also appearing of promise. The remainder were of poorer performance; Wisconsin, Plush, Mars, Tregal, Montcalm, Titan, Compana, Velvet and Rex were badly attacked by *P. glumarum* on the foliage.

As earlier indicated, these varieties will be under larger scale tests during the coming season.

IMPORTATIONS

No hybridization work has so far been carried out with barley: and the breeding programme has as its aim the introduction and testing of varieties both for the lower and hotter altitudes, where feeding barleys are chiefly required, and for the higher and cooler altitudes where both feeding and malting barleys are produced and in which resistance to *P. glumarum* is essential. Good yielding varieties of good straw strength and standing ability are required. Australian barleys, chiefly Prior and Research, form the main varieties for feed and malting purposes with, in addition, the American feeding variety, Glacier, in lower areas.

The following trials of new introductions were carried out on the Plant Breeding Station, Njoro, unless otherwise stated.

1948 Importations

From the Dominion Laboratory of Cereal Breeding, Winnipeg, Canada.—The 21 varieties selected from the original 28 importations were multiplied during the season and they will be further multiplied up on a field scale during 1951.

Sanalta failed to live up to its earlier promise and was found to have weak straw. Some of the varieties were badly attacked at Njoro by ear rust and will, if released to farmers, have to be confined to areas below this altitude.

1949 Importations

From Iraq.—All made poor growth. Iraqui H239 was the worst of the seven and will be discarded. Trabout H231, Californian Chevalier H236 and Chilean H160 will be carried on.

From the Ministry of Agriculture, Orman, Egypt.—Beladi 16 proved to have short straw but made very poor growth. It will again be under trial in 1951.

From S. Rhodesia.—The three varieties under trial, Blue Barley, Black Barley and Trabut, were all attacked by *P. glumarum* on the foliage. Black Barley, a naked variety, produced grain bushelling 63 lb. All will be carried on for trial in 1951.

From Cyprus.—These barleys made poor growth. Cyprus Black will be discarded and the remaining two, Beladi and Paphitico, will be carried on for a further season.

From Potchefstroom, South Africa.—Both Elses and Swanneck were badly attacked by *P. glumarum* and the leaves killed. Swanneck a 2-row variety, however, produced mealy grain busheling 55½ lb. Both will be given further trial.

From Estaçao de Melhoramento de Plantas, Elvas, Portugal.—Eight varieties were under trial, Nos. 4242, 4236, 4261, 4246, 4238, 4244, 4248 and 4249. The first four named showed considerable promise, having good straws, resistance to *P. glumarum* and producing plump samples of grain. They will be further multiplied during the coming season.

From Ethiopia.—A variety with purple glumes. It grew poorly.

1950 Importations.

The following barleys were on trial for the first time:—

From the Plant Breeding Institute, Cambridge.—Earl.

From the Department of Agriculture, Victoria, Australia.—Cape, Sea of Azov, Vaughn and Atlas. The first two had weak straws and lodged; the last two stood well. Vaughn, a smooth awned type, suffered badly from yellowing of the lower leaves.

All these varieties will be carried on to larger scale tests in 1951.

Oats

No breeding work with oats has so far been possible and as with barley the varieties grown are introductions. Lampton, from Australia, still remains the standard for hay and feed and Grey Algerian is the recognized milling variety producing the plumpest samples over 7,500 ft. Under this altitude it becomes rather more susceptible to stem rust. Most varieties, particularly those from Europe, imported for test are too susceptible to stem rust to be released to growers. The American and Canadian varieties listed in the 1949 Annual Report, whilst more resistant to stem rust than those of European origin, are nevertheless attacked to a varying degree and must probably be considered too rust-susceptible for general cultivation in Kenya. Some, particularly R.L.1710 and 1734 from the Dominion Laboratory of Cereal Breeding in Manitoba, Canada, do show more resistance and tests with them are still in progress.

IMPORTATIONS

The following trials were carried out on the Plant Breeding Station, Njoro.

1949 Importations

Sunrise and S.15 from Southern Rhodesia have been discarded due to rust susceptibility. Sunrise in 1949 remained free of this disease and initially showed promise on account of its resistance and good straw.

Aveia castanha from Portugal was badly attacked by stem rust and virtually destroyed.

1950 Importations

The following varieties were under trial for the first time:—

From U.S.D.A., Beltsville, Maryland.—Mohawk, C.I.4327; Bannock, C.I.2592; Victory, C.I.560; Valor, C.I.4137, and Fortune, C.I.5226. All were attacked by stem rust to a fair extent but remained free of crown rust, *P. coronata*.

From the Department of Agriculture, Melbourne, Australia.—Mulga, Early Kherson, New Zealand Cape, Early Bart, Belar, Guyra, Palestine and Orient. Mulga, Early Kherson, Early Bart and Palestine were badly attacked by stem rust: the remainder had a lighter attack. Most had weak straw but Guyra was better in this respect.

From the Dominion Cerealists, Ottawa, Canada.—Ajax 1948, Beaver 1948, 3003.F 1948, Garry 1948 and Beacon 1948. All these varieties were little attacked by stem rust and had no crown rust infection. All had good straws and the last two are noted as particularly promising.

From the Senior Cerealists, Ottawa, Canada.—Larain and Roxton. Both had good straw and were little attacked by stem rust.

From the State Research Farm, Werribee, Victoria, Australia.—Algeribee. This was sown rather late and was badly attacked by stem rust.

All these varieties will be carried on to larger scale trials in 1951.

OBSERVATION PLOTS—OL JORO OROK

At Ol Joro Orok, Yelder and Victory from Britain; Exeter and Marion from the U.S.A.; and S.E.S.387 and Naked Oats from Southern Rhodesia were all badly attacked by stem rust. All except S.E.S.387 and Marion were also attacked by crown rust. The American variety, Boone, and the two Candian varieties, R.L. 1710 and R.L. 1734 had only slight stem and crown rust attacks.

Further trials will be made in the coming season.

Soya Beans

The 26 varieties from the U.S.A., Southern Rhodesia, South Africa and Kongwa (Tanganyika), listed in the 1949 Annual Report, were again under test at Njoro and in the sandveld area of Trans Nzoia at Kitale, 6,000 ft. In addition, Red Tanner from the Experimental Farm, Kongwa, and Lincoln from Beltsville, Maryland, U.S.A., were under test for the first time. Both made very poor growth and shattered badly.

At Njoro, of the ten varieties noted as making rather better growth, 39.S.11, 40.S.35, 41.S.77, 44.S.36, from the College of Agriculture, Potchefstroom, South Africa, and Hernon Nos. 107, 109, from the Salisbury Experiment Station, Southern Rhodesia, were better than the remainder. As noted in past seasons, all the varieties introduced for trial proved to be of poor growth and yield, or subject to shattering, and none has yet been found which appears to offer economic possibilities for large-scale production, involving mechanization, in the European areas of the Colony.

At Kitale eleven varieties, selected from the previous year, were under further test—Ogden, Avoyelles, 39.S.11, 45.S.96, 45.S.100, 45.S.2, 45.S.101, 44.S.36, 45.S.35, 45.S.95 and Hernon. The first five proved better than the remainder in observation plots and will be carried forward into a yield trial during the coming season.

Sunflowers

Mass selection was carried out in the breeding plots of the semi-dwarf varieties, Mars, Pole Star and Jupiter, to purify the type. In addition, a number of single plant selections for dwarfness were made and bagged before flowering. These three varieties have already been released to farmers and are now grown to some extent in the Colony. It has been shown that, except possibly at Kitale, they are capable of yielding as heavily as the commonly grown variety, Giant Black, provided they are spaced more closely, i.e. 18 in. between rows and 8 in. in the row. Giant Black is usually sown in rows 3 ft. apart with plants one foot in the row. This trial was described in the 1949 Annual Report.

These three semi-dwarf sunflowers have been found suitable for combining in the lower and hotter areas, but grow rather too tall in the cooler high rainfall areas over 7,000 ft. where shorter varieties are required.

Three new varieties were under trial for the first time, Klein and Southern Cross from Professor G. Blackman, Oxford; and Mennonite from the Dominion Experimental Station, Manitoba, Canada. Southern Cross grew to an average height of 3 ft., the remainder were somewhat taller. Selections of shorter plants were made in these varieties and further trials will be carried out in 1951.

Sunrise from Kongwa, Tanganyika, failed to germinate.

Maize Seed Competition

This competition, which has as its aim the improvement of maize yields in Kenya by seed selection and the production of high yielding maize on a commercial scale, was again sown at the three centres, Kitale, Njoro and Rongai. Yields were low due to the dry season and averaged 8.45, 11.35 and 8.16 bags* per acre respectively. Full results were published in the local Press and will not be repeated here.

The competition has now been held eleven times and a study of the results achieved over this period brings to light two important points—

- (1) that farmers who select according to the advice of the Agricultural Department invariably do well in the competition; and
- (2) that acclimatization is a most important factor affecting yields and that there is no such thing as a general purpose maize for general use in the Colony.

As a result it has been decided to restrict entries to the section in which any particular farm occurs and permit free competition within sections but not, as in the past, between sections. By this means, it is hoped not only to make the competition fairer to the individual entrant, who would then not compete in an area different from his own and in which his maize would be at a disadvantage, but also to develop the highest yielding strains of seed for use within a particular area or ecological zone. To this end a fourth section at Eldoret is to be opened to serve the Uasin-Gishu Plateau, an area at present not fully represented in the existing set-up.

Maize Breeding

BREEDING PROGRAMME

The breeding programme is following three main lines:—

- (1) Continuation of the original work which was shut down during the war years due to staff shortages.

* 200 lb. net.

- (2) The starting of a completely new programme of inbreeding using—
 - (a) local maize varieties and strains from within the Colony, and
 - (b) imported varieties and hybrids from the U.S.A., Southern Rhodesia and South Africa to obtain genetic diversity.
- (3) Importation of ready-made hybrids and inbreds from the above-mentioned countries to test their suitability for growing in Kenya.

It may be said at once that all imported hybrids compare very unfavourably in performance with local open-pollinated varieties. All are poorer in yield, usually flower early and remain dwarfed, and are attacked by local diseases. The poorest performance has been shown by the U.S.A. hybrids; hybrids from South Africa fare somewhat better, whilst those from Southern Rhodesia have given the best yields, although all so far tried are much poorer than the local variety. This is clearly demonstrated in the trial of local maize against an imported Southern Rhodesian hybrid described later on in the Report.

SUMMARY OF SEASON'S WORK

The following is a summary of the main work carried out during the present season:—

Njoro.—The object is to develop hybrids suited to the higher and cooler maize-growing areas of the Colony.

Two hundred and twenty-three inbred lines were under observation consisting of material carried on from the 1949 programme. They comprised inbreds from the original programme; S.1's of Njoro and Kitale selected field maize and of other local varieties; S.1's of inbreds, single and double crosses from Southern Rhodesia; S.1's of hybrids from the U.S.A. and South Africa; and S.2's from Njoro field maize from the 1948 programme. A collection of local Kenya varieties was made; and new inbreds, single and double crosses from Southern Rhodesia and new hybrids from the U.S.A. and South Africa grown for observation and possible inbreeding.

Top-crosses of inbred $\times$ variety were made on selected new S.1's for testing general combining ability in a top-crosses trial in 1951. 400 single and 120 double crosses were made for yield tests in 1951; and a further 400 plants of open-pollinated field maize were selected and inbred. 200 single plant selections in open-pollinated station maize were crossed in pairs for testing in a yield trial in 1951 in connexion with Dr. S. C. Harland's Intragenotypic breeding method, as the amount of material at present under test is considered insufficient. Approximately 3,000 selfings were carried out at Njoro during the season, in addition to the single and double crosses which were made.

In addition, the following trials were carried out:—(1) A yield trial of the single crosses made from the original inbred lines; (2) a top-crosses trial to test combining ability of the various S.1's undergoing inbreeding; (3) a yield trial to determine the highest yielding combinations made in 1949 in the first stage of Dr. Harland's Intragenotypic method of maize improvement.

Kitale.—The object is to develop lines suited to the hotter and heavier rainfall areas of the Colony and resistant to White Blight, *Helminthosporium turcicum*.

The programme follows much the same lines as at Njoro with the sowing of the old-established inbreds, the collection of local maizes, introductions from the U.S.A., South Africa, Southern Rhodesia and Tanganyika, the S.1's and S.2's of Njoro and Kitale field maize, and from the various introductions, for further selfing and selection.

Rongai.—The object is to develop lines, both white and yellow, for the hotter and drier areas of the Colony.

The following lines of work are in progress:—(1) Local yellow and introduced varieties for inbreeding; (2) continuation of the 1949 programme and the selfing of selected S.1's.

TRIAL OF KENYA MAIZE AGAINST SOUTHERN RHODESIA HYBRID

Two statistical trials were laid down to compare the yields of open-pollinated Njoro Field Selected Flat White maize and the Southern Rhodesia double cross hybrid (T4 × M9) × (N3 × A). Sowing was carried out on 21st April and 8th May. The first date is somewhat later than usual for maize planting at Njoro; and the second very late. Due to this, coupled with the dry weather, yields were low.

Results were:—

	Trial I	Trial II
	April Planting	May Planting
Njoro open-pollinated	7.46	3.86
S. Rhodesia hybrid ..	0.73	1.14
Significant Differences—		
P.05 ..	0.66	0.82
P.01 ...	0.89	1.10

Yields in bags of 200 lb. net per acre

Full details will be published elsewhere but these highly significant results provide a sufficient answer to some local opinion which considers that the importation of ready-made hybrids from other countries, particularly Southern Rhodesia, will lead to an automatic increase in maize yields in Kenya. It has been repeatedly shown that introduced ready-made hybrids are not successful in this country: and the opinion is reiterated that the production of hybrids for growing in Kenya is *ad hoc* work which must be carried out in the Colony. At the same time maize varieties and hybrids from outside Kenya should continue to be imported for possible use in the breeding programme.

It is interesting to record that this same Southern Rhodesia hybrid was also planted on a field scale by two farmers in the hotter Rongai Valley area at 6,000 ft. Again it proved less vigorous than the local variety, was more attacked by disease and gave very small yields, thus bearing out the results of the Njoro trial.

Sorghum

The sorghum breeding programme has two aims:—

- (1) The improvement of local varieties for African use.
- (2) The production of dwarf types, suitable for combining, for use in the European farming areas.

Sorghum is an important crop in African economy, being grown both in the higher rainfall areas and in the more arid country. Any increase in yields or quality will therefore be of benefit to African cultivators.

Sorghum is not grown at present by European farmers owing to the difficulty of harvesting; and the production of successful dwarf types, as in the U.S.A., suitable for combining would do much to popularize the crop. It is considered that sorghum would prove a valuable stand-by in the hotter and drier areas where maize is not a reliable crop.

In order to carry out the above aims a collection of local sorghums is being built up and varieties, particularly dwarf types from the U.S.A., introduced for test. If such introduced dwarf varieties are not themselves immediately suitable for growing in Kenya it should be possible by hybridization with local types to develop varieties suitable for full mechanization whilst retaining or increasing yield and disease resistance.

SUMMARY OF SEASON'S WORK

Njoro

Njoro has too cold a climate for grain sorghums but introductions must first be grown there to increase the seed supply, under adequate supervision, for further tests in more suitable areas. Seed of the nine varieties imported in 1949 from Dr. R. E. Karper, Lubbock, Texas, was increased for further trials. Single plant selections were made in this material.

New Importations.—The following introductions were under test for the first time.

From Mr. A. F. Swanson, Fort Hayes Experiment Station, Kansas, U.S.A.—Cody × Wonder Club H.C. 44-2063, Early Kalo and Ellis.

From Dr. R. E. Karper, Lubbock, Texas, U.S.A.—Combine Kaffir 70 (S.A. 5765-12-5-4), Combine Kaffir 60 (S.A. 5765-22-1-2), Tepiaca 63 (S.A. 5655-2-40-2), Red Combine (S.A. 5507-41-2-24-3), Dwarf Shallu (S.A. 5770-10-4), Dwarf Early Shallu (S.A. 5772-7), Dwarf Early Shallu (S.A. 5772-1-11), Dwarf Shallu (S.A. 5631-12), Combine Kaffir 15 (S.A. 5765-13-1-2), Texioca 54 (S.A. 5871-4-1), Red Combine (S.A. 5507-45-31-26), Redbine 60 (S.A. 5507-3-1-4-4), Redbine 66 (S.A. 5507-31-3-4-11), Miloca 56 (S.A. 5674-12-5-1), Ajax T.S. 13619, Combine (S.A. 7008 X), Hegari T.S. 7313.

Tepiaca 63 and Texioca 54 are waxy combine Kaffir varieties.

From Kongwa, Tanganyika.—Swazi P.41, Swazi P.127, Swazi P.133, Pecks Milo, White Milo, Mangera, Feterita Managil and Potchefstroom 37R9.

From the Department of Agriculture, Uganda.—18 single plant selections in a local variety.

From the Department of Agriculture, Tanganyika.—Seven Durra selections, Wiru Bumabele, Wiru Ukerewe, Wiru Yemba, Ng'hollongo, Bukura Mahemba, Bukura Masaba, Bukura Ngoa, and B.C. Nos. 20, 23, 27, 41, 81, 85.

Most of these proved too late maturing and set no seed.

From the Director of Agriculture, Mahalapye, Bechuanaland.—Rhodesian Milo, Hegari, Short White Swazi 45, M.K.1, M.K.9, M.K.13, Roma White, Trunane, Taungs White, Swazi 74 T.

Seed of these varieties was increased for larger scale tests in 1951.

Scott Agricultural Laboratories, Kabete, 5,700 ft.

All the above varieties were under test in the "long rains" season where growth was better owing to the lower altitude but could not be described as satisfactory due to the cold and overcast weather in July and August.

Machakos, 5,000 ft.

Observation plots of some American dwarf varieties and introductions from Bechuanaland were sown at Machakos during the "short rains" season. This season is characterized by long bright periods and showers followed by a hot ripening period, and is quite different from the "long rains" season earlier on in the year in which the rains are followed by cool, damp weather for two months.

All varieties made excellent growth, were little attacked by pests and diseases, and ripened in approximately $4\frac{1}{2}$ months. Taungs White from Bechuanaland and Caprock and Black Kaffir from the U.S.A. were particularly promising.

Pyrethrum

The following summary of the pyrethrum breeding work for the season is supplied by the Senior Agricultural Officer, Ol Joro Orok.

The parent clones of the 188 × 214 cross were bulked vegetatively during the first six months of the year. By the beginning of July 28,000 young plants

were ready for transplanting into isolated seed production fields and a total of 2.6 acres was planted out. The young plants made good growth and were coming into production towards the end of the year.

Two correlations on groups of selections derived from ordinary bulk pyrethrum revealed a statistically significant negative correlation between pyrethrins content and yield of flowers. There is thus a danger that selection for high content alone may result in poorly yielding strains showing little or no improvement in the yield of pyrethrins per acre. In order to overcome this difficulty, crosses have been made between high content clones and a vigorous low content strain. Yield trials have shown that whilst the pyrethrin contents of the crosses are not generally as large as those derived from two high content parents, yet the increased vigour more than compensates for the decrease in content. Selections were made within these crosses in an attempt to find individuals combining the good qualities of both the parents to an exceptional degree.

Preliminary trials of colchicine as a seed treatment did not give encouraging results.

It is expected that the first seed issue of 188×214 will be made towards the end of 1951. This cross is primarily a low altitude one. Work is proceeding on the production of a high altitude strain. One cross in particular, 127×481 , has given exceptionally good results both as regards yield and pyrethrins content. Full-scale bulking of the parent clones is now in progress with a view to making a seed issue to high altitude growers as soon as possible.

Miscellaneous Crops

The following introductions were under trial for the first time. All were sown in isolated plots to increase the seed supply for larger scale tests in 1951.

Dwarf Castor Beans from Mr. J. R. Quinby, Chillicothe, Texas, U.S.A.—Nos. 1, 72, 73, 74, 93 and Conner. They were sown both at Njoro and at the Scott Agricultural Laboratories, Kabete.

All grew well and proved to be non-shattering although some, particularly No. 1 and Conner, grew too tall for combine harvesting.

Oil Poppies from Professor G. E. Blackman, Oxford.—Mahndorfer and Peragis. No germination at Njoro, 7,100 ft.: good growth at Molo, 9,300 ft.

Oil Rapes from Professor G. E. Blackman, Oxford.—Black Argentine, Liho, Sweet German and Regina. Growth was rather better at Molo than at Njoro.

Louisiana Green Velvet Okra from Mr. J. R. Quinby, Chillicothe, Texas, U.S.A.—Very poor growth was made both at Njoro and at Rongai, 6,000 ft.

Experimental Work

WHEAT RATE OF SEEDING TRIALS

These trials, carried out in conjunction with Agricultural Officers, have as their object the determination of the lowest seeding rates to give satisfactory yields.

The varieties used were the same as in 1949, i.e. 294.B at Eldoret and D.C. $\times$ Ceres at Ol Joro Orok. In addition, six new trials were started: one at Eldoret using 294.M, two trials at Njoro and Rongai using 294.M and 360.H, and two at Molo using Equator and 318.O.3.B.2, making nine trials in all. The trial at Kitale was not sown.

Seeding rates and yields are given in the following table. Plots were $1/5$ th acre each and four replications were laid down in a randomized block layout, except the Ol Joro Orok trial which consisted of two replications only. Seeding rates aimed at were 30, 50, 70, 90, 110, 130 and 150 lb. per acre.

NJORO (7,100 ft.)				RONGAI (6,000 ft.)				MOLO (9,300 ft.)				ELDORET (7,800 ft.)				OL JORO OROK (7,800 ft.)			
360.H		294.M		360.H		294.M		Equator		318.O.3.B.2		294.M		294.B		D.C. × Ceres			
S.R.	Yld.	S.R.	Yld.	S.R.	Yld.	S.R.	Yld.	S.R.	Yld.	S.R.	Yld.	S.R.	Yld.	S.R.	Yld.	S.R.	Yld.		
121	7·26	122	7·05	62	6·83	83	6·43	124	7·72	83	9·83	102	8·69	116	5·97	50	9·38		
94	7·11	139	6·97	70	6·68	114	6·31	89	7·06	65	9·81	153	8·68	133	5·67	70	8·20		
59	7·03	78	6·93	82	6·66	131	6·30	59	6·80	117	9·78	85	8·58	88	5·43	30	7·91		
151	6·97	94	6·91	114	6·53	74	6·03	49	6·52	103	9·67	50	8·58	77	5·13	110	7·70		
83	6·96	61	6·77	139	6·49	61	6·02	108	6·47	52	9·58	133	8·47	65	4·86	150	7·08		
57	6·62	61	6·76	39	5·49	38	5·34	70	5·93	145	9·20	58	8·41	39	4·75	90	7·02		
41	5·78	46	6·05	27	5·11	26	4·56	36	5·62	38	8·44	33	7·82	27	3·69	130	6·98		
P.01	0·47		0·75		1·14		0·68		1·57		1·04		0·53		1·17		Not Sig		
P.05	0·34		0·55		0·84		0·49		1·12		0·76		0·39		0·86				

At Njoro with 360.H all seeding rates are better than the lowest used, 41 lb. per acre, at the 1 per cent point; and all are better than 57 lb. at the 5 per cent point. There are no differences between the remaining rates. With 294.M all rates are better than 46 lb. at the 5 per cent point; there are again no differences between the remainder.

At Rongai with 360.H there is no difference between rates 27 lb. and 39 lb. All rates over 39 lb. are better than 27 lb. at the 1 per cent point and all are better than 39 lb. at the 5 per cent point. The remainder are equal. With 294.M, 38 lb. is better than 26 lb. at the 5 per cent point and all are better than 38 lb. at the 1 per cent point. There are no differences in the remainder.

At Molo with Equator rates of 59 and 89 lb. have given higher yields than 36 lb. at the 5 per cent point and 124 lb. at the 1 per cent point; and 124 lb. is better than 70 lb. at the 5 per cent point. There are no differences in seeding rates of 36, 49, 70 and 108 lb. per acre. With 318.O.3.B.2 all rates are better than 38 lb. but no differences are shown between rates of 52 to 145 lb. per acre.

At Eldoret with 294.M all rates have shown an increase over 33 lb. No differences occur between rates of 58 to 133 lb. per acre. With 294.B all rates are better than 27 lb. and rates of 116 and 133 lb. have given higher yields than 39 lb. at the 1 per cent and 5 per cent point respectively, whilst 116 lb. has shown a better return than 65 lb. There are no differences between rates of 77 to 116 lb. per acre.

At Ol Joro Orok the differences measured fall within the limits of experimental error and no conclusions can be drawn. There is a tendency for the lower seeding rates to show the heavier yields.

Conclusions

Summing up this season's results it is seen once again that there is little difference in yields of wheat over a wide range of sowing rates, which bears out the results of the earlier trials. The year under review proved again to be a dry one and it may be expected that in a wet year the heavier sowing rates would tend to lodge. Observation showed, as in the previous trials, that heavier sowings tended to ripen earlier. In general, the tendency is for seedings of less than 50-70 lb. to reduce yields: above this figure yields remain relatively constant up to the highest sowing rates used, 151 lb. per acre. It is intended to carry on these trials for a further period to smooth out seasonal effects.

Summary of Results at Eldoret and Ol Joro Orok for the Three Years 1948-1950

At Eldoret and Ol Joro Orok three years' results have now been obtained. At both centres there is a marked and sudden increase in yields from a seeding rate of 30 lb. per acre to 45-50 lb. per acre. At Eldoret yields rise steadily and progressively from this rate up to 98 lb. per acre after which there is a slight recession. At Ol Joro Orok the figures are difficult to interpret and there appears to be a sudden and unexplained drop in yield from a seeding rate of 50 to 70 lb. per acre followed by a further rise to 110 lb. per acre after which a drop again takes place.

ELDOROT 294.B		OL JORO OROK 318.O.3.B.2	
Seeding rate lb./acre	Yield Bags per acre	Seeding rate lb./acre	Yield Bags per acre
29	5.43	30	8.83
45	5.93	49	9.47
64	6.30	70	8.93
83	6.47	91	8.78
98	6.90	110	9.17
125	6.87	129	8.93
141	6.80	151	8.57

The interpretation of these results must await statistical analysis which had not been carried out at the time this report was written.

BARLEY RATE OF SEEDING AND FERTILIZER TRIAL

Object.—To test the effect on yield of three barley varieties of two seeding rates with and without muriate of potash.

Varieties.—Prior, Research and Mariout.

	SEEDING RATE USED (lb./acre)		
	Prior	Research	Mariout
(1)	75	65	70
(2)	143	132	169

Fertilizer.—O and $\frac{1}{2}$ cwt. muriate of potash per acre.

Layout.—Randomized blocks with four replications and 12 treatments. Plots 40 ft. long, of which 2 ft. at either end is discarded, eight rows 8 in. apart sown with Planet Junior.

1—YIELDS IN BAGS OF 180 LB. NET PER ACRE

Variety	FERTILIZER			Variety	SEEDING RATE		
	0	Kcl	Mean		1	2	Mean
Research ..	9.67	9.79	9.73	Research ..	10.11	9.36	9.73
Mariout ..	6.84	7.24	7.04	Mariout ..	6.67	7.41	7.04
Prior ..	6.49	6.93	6.71	Prior ..	6.68	6.75	6.71
MEAN ..	7.66	7.98	7.83	MEAN ..	7.82	7.84	7.83

Fertilizer	SEEDING RATE		
	1	2	Mean
0 ..	7.77	7.55	7.66
Kcl ..	7.86	8.11	7.98
MEAN ..	7.82	7.83	7.83

Variety Means only.

Sig. Diff. $P=05$ 1.02 bags per acre

$P=01$ 1.37 " " "

Seeding Rate and Fertilizer Means not significant.

Conclusions.

- (1) Research has outyielded Mariout and Prior at the 1 per cent point.
- (2) There is no difference in yield between Mariout and Prior.
- (3) Increasing the seeding rate from 70 lb. to 150 lb. per acre approximately has had no effect on yield.
- (4) Application of muriate of potash at $\frac{1}{2}$ cwt. per acre has had no effect on yield.
- (5) The intractions variety $\times$ fertilizer, variety $\times$ seeding rate, seeding rate $\times$ fertilizer, and variety $\times$ fertilizer $\times$ seeding rate, are all non-significant.

2—BUSHEL WEIGHT OF GRAIN* (LB.)

Variety	FERTILIZER			Variety	SEEDING RATE		
	0	Kcl	Mean		1	2	Mean
Research ..	48.75	50.63	49.69	Research ..	49.25	50.13	49.68
Mariout ..	43.88	43.63	43.76	Mariout ..	43.75	43.75	43.75
Prior ..	51.00	51.25	51.13	Prior ..	51.00	51.25	51.13
MEAN ..	47.88	48.50	48.19	MEAN ..	48.00	48.38	48.19

Fertilizer	SEEDING RATE *		
	1	2	Mean
0	47.17	48.58	47.88
Kcl	48.83	48.17	48.50
MEAN ..	48.00	48.38	48.19

Conclusions

- (1) The bushel weight of the 2-row malting barleys Research and Prior is higher than the 6-row feeding barley Mariout.
- (2) Muriate of potash had no appreciable effect on bushel weight except possibly with Research where some increase is observed due to potash application.
- (3) Increased seeding rate has had no appreciable effect on bushel weight.

3—1,000 CORN WEIGHT OF GRAIN* (GRS.)

Variety	FERTILIZER			Variety	SEEDING RATE		
	0	Kcl	Mean		1	2	Mean
Research ..	36.50	35.41	35.96	Research ..	36.58	35.34	35.96
Mariout ..	31.72	31.85	31.78	Mariout ..	31.28	32.28	31.78
Prior ..	36.68	37.36	37.02	Prior ..	36.71	37.34	37.02
MEAN ..	34.97	34.87	34.92	MEAN ..	34.86	34.99	34.92

Fertilizer	SEEDING RATE		
	1	2	Mean
0	35.25	34.68	34.97
Kcl	34.46	35.29	34.87
MEAN ..	34.86	34.99	34.92

Conclusions

- (1) The 1,000 corn weights of the 2-row varieties Research and Prior are larger than the 6-row feed variety Mariout.
- (2) Neither muriate of potash nor seeding rate has had any appreciable effect on 1,000 corn weight.

NITROGEN PERCENTAGE OF GRAIN*

Variety	FERTILIZER			Variety	SEEDING RATE		
	0	Kcl	Mean		1	2	Mean
Research ..	2.20	2.10	2.15	Research ..	2.04	2.26	2.15
Mariout ..	2.16	2.22	2.19	Mariout ..	2.16	2.22	2.19
Prior ..	2.24	2.29	2.27	Prior ..	2.18	2.35	2.27
MEAN ..	2.20	2.20	2.20	MEAN ..	2.13	2.28	2.20

Fertilizer	SEEDING RATE		
	1	2	Mean
0	2.15	2.24	2.20
Kcl	2.10	2.30	2.20
MEAN ..	2.13	2.27	2.20

Conclusion

Neither muriate of potash nor seeding rate has had any appreciable effect on nitrogen content of the grain. There is a suggestion that nitrogen content has increased slightly with heavier seeding.

APPLICATION OF NITROGEN TO WHEAT AFTER PLOUGHING-IN OF STUBBLE

Object.—A common objection raised by some farmers to ploughing in straw residues from the wheat crop, as opposed to burning, is that this practice leads to reduced yields in the following crop. This may be due to nitrogen deficiency caused by rotting down the large amount of straw ploughed under. Accordingly, nitrogen was applied as sulphate of ammonia either before sowing or at specified intervals after sowing to test this theory. The trial was carried out in conjunction with the Agricultural Officer at Eldoret.

Area of Trial.—Eureka Estates, Sergoit, Eldoret, 7,000 ft. approximately.

Variety.—Sabanero.

Treatments.—Basic phosphatic dressing of $\frac{1}{2}$ cwt. superphosphate and $\frac{1}{2}$ cwt. guano per acre. Nitrogen applied as 1 cwt. sulphate of ammonia per acre.

Layout.—Randomized blocks with four replications. Plots $\frac{1}{5}$ th acre each.

Results.—The following are the results obtained.

Treatment	Bags per acre (200 lb. net)
1. Control—no nitrogen	4.2
2. Application 1 month prior to sowing ..	3.8
3. Application with the seed in May ..	4.0
4. Top dressing in July	4.0
5. Top dressing in September	3.9
6. Application $\frac{1}{2}$ at seeding and $\frac{1}{2}$ in July as top dressing.	4.2

Treatments not significant.

* *Note.*—The determinations of bushel weight, 1,000 corn weight and nitrogen content were carried out on single bulked samples and statistical interpretation of the results is therefore not possible.

Conclusion

No differences occurred between the various treatments.

SUNFLOWER VARIETY TRIAL

Only one sunflower trial was laid down during the season and this was at Ol Joro Orok (7,800 ft.) in conjunction with the Agricultural Officer.

Object.—To compare the yields of the semi-dwarf varieties, Mars, Pole Star and Jupiter, with the standard variety Giant Black.

Spacing.—Giant Black rows 3 ft. apart, seeds 1 ft. in the row. Semi-dwarf varieties rows 18 in. apart, seeds 8 in. in the row.

Plot Size.—Plots 34 ft. long $\times$ 9 ft. wide.

Layout.—Randomized blocks with 12 replications.

Results.—

Variety	Per cent stand at germination	Per cent stand at harvest	Days to harvest	YIELDS (bag of 100 lb. net p.a.)
Mars	80	70	102	14.7
Jupiter	75	65	102	10.4
Pole Star	85	75	107	9.2
Giant Black	84	80	124	13.1

Sig. Diff. P. 05 = 1.1

P. 01 = 1.5

Conclusions

At the spacings given Mars has outyielded the rest at the 1 per cent point.

Giant Black has outyielded Jupiter and Pole Star at the 1 per cent point and Jupiter has outyielded Pole Star at the 5 per cent point.

The results of the trials carried out at Njoro, Rongai and Ol Joro Orok show that the semi-dwarf varieties can yield as highly as, or outyield, Giant Black provided the spacing is reduced to give considerably more plants per acre to compensate for the smaller individual size and yield.

Mars has proved the heaviest yielder but grows rather too tall in the higher areas for combining. Jupiter, although of somewhat lower yield, may be more successful in this respect.

Acknowledgments

My thanks are due to Dr. R. M. Nattrass, Senior Plant Pathologist, for testing and identification of physiologic stem rust forms and for the production of material for artificial rust epidemics in the breeding cages; to Mr. E. W. Gaddum, Senior Agricultural Officer (Pyrethrum), for supplying the data in the section on pyrethrum; and to Mr. P. Robinson, Statistician, East African Agriculture and Forestry Research Organization, for advice on experimental layouts.

H. C. THORPE,
Senior Plant Breeder.

ANNUAL REPORT OF THE SENIOR ENTOMOLOGIST (COFFEE)

The investigational work of the Entomological Section of Coffee Services has been interrupted frequently during the past year by urgent calls from various parts of the coffee areas in Kenya for assistance in connexion with pests. While the entomologists are always anxious to help in matters of this kind, and naturally regard it as part of their duty, a year such as we have come through which provides so many entomological "headaches", is bound to have a disruptive influence on any planned research programme. On the other hand, many opportunities are provided for the accumulation of field observations, which are of such great importance in this subject.

In spite of the calls of advisory work, Mr. McCrae made good progress in his studies on the use of some of the newer insecticides in coffee. In view of plans for Mr. McCrae to visit Uganda to collect further mealybug parasites for trial against *Pseudococcus kenya* Le Pelley, on Mr. Melville's return from leave, considerable study of Mr. Melville's collections and safari records was necessary to prepare for this project. Mr. McCrae left Kenya for Uganda on 5th March, 1951.

It is proposed to give some notes on the pests which have come in for attention during the year:—

Coffee Thrips

(*Diarthrothrips coffeae* Williams)

In the early months of 1951, Thrips populations caused serious damage when neglected and necessitated control measures on a large acreage. Paris Green has again not been available in Kenya and D.D.T. has been widely used both by planters themselves and by commercial spray contractors. The Paris Green-molasses-lime spray, first introduced in 1945, is still recommended for normal conditions. When the leaf is badly wilted, however, this spray can be ineffective. The reason for this is thought to originate in the method of feeding of the Thrips. When feeding, a Thrips applies its mouth-cone to the leaf surface and its contained stylets are pushed out to puncture and lacerate the leaf tissues. The plant sap wells out from the lacerated puncture and the insect then uses its mouth-cone (the stylets having been withdrawn) to suck the sap into its gut. It is in this way that the deposit of soluble arsenic from the Paris Green spray mixes in the sap and is ingested by the Thrips. On theoretical grounds a high turgidity of leaf should result in a quicker and greater sap-flow with consequent high kill. All available field evidence supports this theory. Under the serious drought conditions which have prevailed in the past two seasons, serious leaf-wilt has been common, and low leaf turgidity has meant low kill. On such coffee there has been no alternative to D.D.T. spraying. 0.1 per cent D.D.T. Wettable Powder sprays have generally been used. Clear evidence is now accruing, however, to show that one must expect a serious disturbance of normal biological control in coffee thus sprayed and this is especially true when the Common Coffee Mealybug is present. A less dangerous alternative than these D.D.T. sprays to the Paris Green spray is clearly required and work on this point is in hand.

Previous work showing the ineffectiveness of B.H.C. on Thrips has been confirmed.

Antestia

This pest has not, in general, been as prevalent as usual this year, though in certain districts, notably Upper Kiambu and Mount Elgon, it has been serious.

Common Coffee Mealybug

(*Pseudococcus kenya* Le Pelley)

A special investigation on mealybug was carried out in Upper Kiambu district early in the year. This was reported on in full in the Coffee Board Bulletin

for July, 1950. In general, the course of events over the past ten years seems to indicate that the mealybug has been somewhat more persistent and less effectively controlled by parasites in Upper Kiambu than elsewhere in the mealybug area. Main points brought out by investigations were (i) that the attendant ant *Pheidole punctulata* Meyr., is now more widespread in Upper Kiambu than formerly; (ii) that the introduced parasite *Anagyrus kivuensis* Comp., although known to breed freely in the district might be more seriously depressed by the greater intensity and duration of the annual cold season in this district; (iii) that part of the trouble was localized failure of *A. kivuensis* caused by hyperparasites such as occurs locally throughout the mealybug area; (iv) that, when parasite failure has occurred, ant-control measures taken have been in general inefficient.

Later in the year it became evident that a general and serious parasite failure was occurring in the whole East Rift area. This appeared to be a direct failure on the part of *A. kivuensis* itself, and distinct from failures involving hyperparasites. A similar failure had occurred once before in the period October, 1945, to March, 1946, and on this as well as on the present occasion an abnormally long period of very dry weather was a feature. Either this unusual dryness, or more than usually cold weather in July and August, or a combination of both, would appear to be a likely cause of such failures. Though serious, such failures are temporary in nature and the position has since improved very markedly.

Mr. McCrae left for Uganda in March, 1951, to commence the long-deferred importation of further natural enemies. The aim of this project is to improve the valuable biological control which has already been achieved, but which experience has shown to be capable of periodic failures of varying severity and extent produced by a variety of causes.

Extension work has been carried out to impress on growers the need to recognize when parasite failures are occurring and thereupon to institute effective ant control measures as was done in the past before the Uganda parasites were introduced. Banding grease is still recommended for this purpose and if efficiently used it is usually not long before a clean-up of mealybug is produced by predators. Various forms of D.D.T. stem treatments have been used in lieu of banding grease but, though sometimes effective, they are generally less reliable than banding grease. B.H.C. dusts applied around the base of the tree were very effective in the dry season but recommendation of these products has now been withdrawn since all B.H.C. insecticides have come under suspicion as the cause of the new and undesirable flavour in coffee known as "bricky".

Two banding grease trials have been carried out in order to recommend desirable formulations for bulk supplies. A large field trial was carried out to compare the effects of various methods of ant control and the direct effect of certain organo-phosphorous insecticides, including systemics, on the mealybug itself. Of the ant control measures, the value of good banding grease as a practical measure for the grower was confirmed. Dieldrin, used for the first time in this trial gave very promising results. One proprietary formulation of D.D.T. gave good protection against ants. B.H.C. dusts while giving good protection in dry conditions broke down very badly after even very light falls of rain. B.H.C. wettable powders gave poor protection.

None of the insecticides applied directly as sprays against the mealybug achieved a high enough degree of control, though some were sufficiently promising to make the question of the correct timing of a second application worthy of a further trial in due course. If it could be found, a means of attacking mealybug directly, would be of value especially to protect young sucker growth and to assist the grower to get his crop when parasite failure occurs locally. A very high degree of control would be essential, however, especially if the chemicals used were persistent and interfered with biological control.

In a further trial using 1.5 per cent Dieldrin Emulsion bands sprayed on to form a 6 in. "sock" on the stems of 100 trees gave complete protection from ants for ten weeks in an area where mealybug and ants were very active. A further field test of this insecticide on a large scale is envisaged.

Routine breeding and liberation of *A. kivuensis* has continued as usual during the year. This activity has assumed increased importance because liberations are considered to be well worthwhile following the use of persistent insecticides. Time must be allowed for spray deposits to weather before liberations are made.

White Borer

(*Anthores leuconotus* Pasc.)

Two compulsory control campaigns were conducted in 1950 and a third campaign from January to March, 1951. The areas affected are the Makuyu, Maragua, Donyo Sabuk and Mitubiri Districts. Planters are compelled by law to take the following steps to the satisfaction of an inspector:—

- (a) Dig a conical depression about 6 in. deep round the base of each and every tree on the plantation; these depressions to be left open for three or four days by which time fresh frass will show which trees contain active boring larvae.
- (b) Treat infested trees by inserting a small piece of cotton wool soaked in E.D.C.T.-petrol mixture into each tunnel entrance and plugging the hole with clay. E.D.C.T.-petrol mixture contains Ethylene dichloride (75 per cent) and carbon tetrachloride (25 per cent) together with an equal volume of lead-free petrol.

These campaigns have resulted in a very satisfactory control being established and it is hoped that an annual campaign will suffice to maintain this position in the future. In addition to the above compulsory measures, planters are urged to hand-collect and destroy adult beetles during the rains.

Black Borer

(*Apate monacha* Fabr.)

A number of reports of damage by this borer have come in from widely scattered districts, including Lumbwa, Ruiru and Makuyu. It is only the adult beetle which bores in the stem of coffee trees. E.D.C.T.-petrol mixture, as used in White Borer control, is now recommended to control this pest.

Elgon Berry Borer

(*Eucosma nereidopa* Meyr.)

This pest has now been identified as *Eucosma nereidopa* Meyr., an insect known as a coffee pest on the Uganda side of Mount Elgon. It has caused serious losses in Elgon plantations and further work on it is required.

The Lace-wing Coffee Bug

(*Habrochila placida* Horv.)

This pest has caused severe damage in Turbo district and has proved difficult to control. It has never been recorded in coffee in Kenya before, though it has been known in Uganda, Tanganyika and the Belgian Congo. Further investigation is needed, particularly to attempt to establish whether extensive use of D.D.T. sprays to control *Antestia* has caused an upset in the natural control of *H. placida*, an insect indigenous in the Turbo area. The insect is known to be attacked in Uganda by a Capsid bug, the controlling effect of which is considered to be of great importance. An investigation of coffee estates hitherto untreated by D.D.T. has been commenced.

Tip Stem Borer

(*Cacoecia occidentalis* Wlsm.)

This insect has caused damage in Upper Kiambu and Teita during the year.

The Tomato Fruitworm

(*Heliothis armigera* Hb.)

Larvae of this moth caused concern, especially in the Solai area in June, by attacking green coffee cherry on a considerable scale. It was discovered that the caterpillars had been feeding on certain weeds, and that when the coffee was weeded they turned their attentions to the coffee. A similar occurrence was reported in the Departmental Annual Report for 1926.

Dangers of the Use of Persistent Insecticides in Coffee

Preliminary laboratory tests, using *A. kivuensis* as the test insect, indicated that D.D.T. applied to coffee, e.g. as sprays to control *Antestia*, Capsid and Thrips, might have a serious effect on biological control. This work which is considered to be of the highest importance will be continued but already an ever-increasing volume of field evidence is becoming available to illustrate the extent of this problem in coffee—a crop with a vast complex of associated insects.

The obvious line is to avoid the use of such insecticides whenever possible, but if they must be used the problem is to learn how to use them, i.e. formulation, time and strength of application, etc., so that the least possible interference with natural enemies results.

Insecticide Supplies

The position during the year has not in general been very satisfactory. Supplies of banding grease have been inadequate and Paris Green has been unobtainable this season. D.D.T. supplies have been uncertain and as research on "Bricky" flavour has shown that there is little doubt that it is produced by B.H.C. insecticides, these can no longer be recommended with confidence for use in coffee, and the position has accordingly been further aggravated. Trials with new deodorized B.H.C. formulations are in progress.

A. R. MELVILLE,
Senior Entomologist (Coffee).

ANNUAL REPORT OF THE AGRICULTURAL OFFICER (COFFEE SERVICES) FOR 1950

Field Trials—Coffee Research Station

Copper Spray Trials—Trial I.—The layout and design of the trial were first described in the 1947 Annual Report. Copper sprays were applied on 31st May during the peak of the long rains growth period. Cherry yields, leaf-fall and die-back were recorded for the fourth year. Counts of leaf-fall recommenced on 14th June and continued at fortnightly intervals until the end of the year. In common with the rest of the coffee on the estate, unusually low yields and leaf-fall were recorded: in consequence the proportion of leaf to crop was higher throughout the trial than in previous years. In such circumstances any response to treatments would probably be due to residual effects of treatments on flowering rather than an effect on crop imposed by sprays applied after flowering had occurred. Analysis of cherry yields showed that the difference between treatments was confined to a small but real increase in crop from plots sprayed with Perenox when compared with those receiving Burgundy or compared with the unsprayed plots. Although the leaf crop ratio was high all sprays effectively reduced the occurrence of die-back in comparison with unsprayed trees.

The sum of four years' yields showed the following differences between treatments. All types, rates and concentrations of sprays led to heavier crop than that recorded from the unsprayed trees.

Sprays of $2\frac{1}{2}$ per cent strength produced heavier yields than those of 4 per cent. This effect is attributed to a particular interaction of concentration and rate, namely that the $2\frac{1}{2}$ per cent spray (C_2) at both $\frac{2}{3}$ pints per tree (R_1) and $1\frac{1}{3}$ pints per tree (R_2) gave greater yields than the 4 per cent sprays (C_3) at $\frac{2}{3}$ pints per tree, but not more than the combination (C_3R_2). The pattern of the interaction was not regular for all types of sprays however; while reactions to Bordeaux and Burgundy were similar a different reaction to Perenox sprays was evident. The yields as hundredweights per acre were:—

	TYPE OF SPRAY			CONCENTRATION			RATE		
	Bor-deaux	Bur-gundy	Pere-nox	1%	$2\frac{1}{2}$ %	4%	Nil	$\frac{2}{3}$ pints	$1\frac{1}{3}$ pints
Clean Coffee, 1950	1.16	0.92	1.65	1.28	1.33	1.12	1.08	1.29	1.19
Cherry, 1950 ..	7.63	6.04	10.85	8.42	8.75	7.34	7.07	8.49	7.85
4 years' yields of cherry ..	102.6	106.3	106.7	106.4	112.4	96.8	72.2	101.2	109.2
Per cent of control	142	147	148	147	166	134	100	140	151

Coefficient of variation for 1950 yields was 40 per cent and 12 per cent for the four year totals.

Sprays reduced die-back in 1950 by 61 to 74 per cent.

Copper Spray Trials—Trial II.—First described in the 1948 Annual Report the trial was continued for the third year. Copper sprays (2 per cent Burgundy at $1\frac{1}{3}$ pints per tree) were applied on 13th May (early spray), 1st June (middle spray), 11th July (late spray). Counts of leaf-fall recommenced on 21st June and continued at fortnightly intervals until the end of the year. Yields were low and variability within treatments was high: no differences between treatments attained significance. Although die-back branches within the trial were few, counts made in December showed that all sprays had reduced die-back by 49 per cent to 75 per cent of controls. Die-backs on plots receiving the early spray was significantly less than that on the late sprayed plots.

The yields recorded as hundredweights of clean coffee per acre were:—

1950	Early	Middle	Late	Early+ Middle	Early+ Late	Middle +Late	No spray	Sig. diff.
Yield	0.29	0.34	0.44	0.34	0.35	0.44	0.53	0.26

Thus the average yield was less than 50 lb. of clean coffee per acre; the coefficient of variation was over 50 per cent of the mean.

Pruning Trial.—The trial was first described in the Annual Report of the Officer in Charge (Coffee Services) for 1946. Since regeneration in 1945 the comparative yields for the four treatments are illustrated by the table below:—

YIELDS—CWT. PER ACRE

Cherry	Multiple stem	Single stem (uncapped)	Single stem (capped)	Single— two stem	Significant differences
1946 ..	14.8	10.2	3.7	13.4	2.4
1947 ..	88.4	53.3	47.2	67.6	10.7
1948 ..	17.1	6.7	10.4	4.9	6.3
1949 ..	38.6	25.7	23.8	20.6	6.7
1950 ..	7.6	18.3	9.8	9.2	9.1
Total Cherry	166.5	114.2	94.9	115.7	18.4
Total Clean Coffee ..	25.0	15.6	13.0	17.4	6.6

The multiple stem system of regeneration produced higher yields than the other methods except in 1950 when the level of cropping was low. The practice of capping single stem trees after regeneration resulted in lower total yield of cherry, but owing to better cherry to clean coffee ratios the clean coffee yield was not significantly lower. It is apparent that the crop borne after regeneration is closely associated with the amount of bearing wood produced by the four systems.

Shade Tree Trial.—Recording of yields continued for the second year. Observations made during 1949 and 1950, both years of low rainfall, indicate that all the shade tree species compete with the coffee for available soil moisture and depress the quantity and quality of crop produced.

Fermentation Trial.—The scope and layout were described in the 1949 Annual Report. It was apparent while the trial was in progress and later confirmed by the scores derived from the liquoring reports on the samples taken that there was a distinct interaction of washing and type of fermentation. This reaction was not foreseen when the trial was designed, nor was it appreciated that the replication would be thus reduced. For the purposes of analysis therefore, the effect of treatments had to be assessed separately according to the type of fermentation. There was no consistent effect on quality due to pre-washing or washing during fermentation on coffee fermentated dry or under water.

For comparison with bulk fermentation sub-samples were fermented in basins and treated as a full replication of the main trial; from these two sets of sub-samples it was found that coffee in the second part of the trial was of similar quality to the bulk samples fermented at the same time in main tanks, whereas the first part of the trial yielded sub-samples of inferior quality to the bulk samples.

having the same treatment. The inferiority was particularly marked in those subsamples which were fermented without water. From the table below it will be seen that the coffee used in both parts of the trial was of poor quality and not entirely suitable material for the purpose. The results obtained confirm the contention implicit in previous work on the subject that trials on all aspects of coffee preparation must be conducted on coffee in bulk form. Considerable replication and repetition is needed in order to overcome the variable response to treatments which is typical in investigation on coffee preparation. In terms of normal classification of Grade A coffee the mean values obtained by samples were as follows:—

	PART I		PART II	
	Main tanks	Basins	Main tanks	Basins
Dry fermentation	5.9	7.0	5.0	4.7
Under water fermentation	5.8	6.8	5.0	4.6

Other Trials on the Coffee Research Station.—In co-operation with the Agricultural Chemist the cultivation, manurial and mulch trials were continued. A joint progress report including the results obtained from these trials was published in the April edition of the East African Agricultural Journal. Later results are contained in the Agricultural Chemist's annual report for 1950.

Field Trials on Sub-stations.

Anmer Estate, Kiambu.—The layout of both variety trials reported here was described in full in the 1948 Annual Report. A summary of the results obtained to date is given below.

Variety Trial I.—Yields have been estimated by recording the weight of cherry from six individual trees of each variety in comparison with 20 control trees of French Mission type interspersed throughout the area of the trial. A statistically valid comparison of each variety with its adjacent controls has shown that the selections S.L.9, S.L.14 and S.L.17, were superior and S.L.3 inferior in yield to the French Mission coffee. Bulk samples have been taken at every picking to enable estimation of yields as clean coffee. Over five years the total yields of clean coffee were:—

FIVE YEARS' YIELDS: AS CWT. OF CLEAN COFFEE PER ACRE

Selection	SL 3	SL 9	SL 14	SL 17	SL 28	SL 30	SL 34	K.S.	J2D	Control
Total Yield	17.9	21.4	18.9	17.7	21.3	23.7	22.1	21.1	20.5	12.1
Mean per Annum	3.6	4.3	3.8	3.5	4.3	4.8	4.4	4.2	4.1	2.4

Variety Trial II.—By similar means the productivity of ten selections was compared with controls of S.L. 28. Yields for three years in hundredweights of clean coffee per acre were:—

Selection	SL 10	SL 33	M 6	M 65	M 83	Kit 37	Kit 61	Kit 85	Kit 145	Kit 251	Control
Total Yields	3.2	2.3	3.6	2.1	3.7	4.3	3.2	0.9	4.8	3.5	2.5

Significant differences in the yields above were three, viz. S.L.10 greater than control, M. 65 and Kit. 85 less than control.

North Kitito Estate, Makuyu.—Recording of quantity and quality of coffee from 12 selected trees of the leaf rust resistant type K. 7 was continued.

Kitale Experimental Station.—During the year the treatments of both the manurial and mulching trials were modified to include the use of cover crops and nitrogen. The subsequent cherry yields indicate no immediate reaction to the new treatments.

Kapretwa Estate, Mount Elgon.—Clean coffee yields of 25 parent trees of Kapretwa Series A were recorded for the second year.

Variety Trials.—The first stage of the programme of variety trials was completed during the year with the planting of the following trials:—

Coffee Research Station (16), Embu Agricultural School (5), miniature trials: two in Solai District (16), two in Embu District (5), one in Meru District (5), one in Machakos District (5). The figures in brackets indicate the number of varieties included in each trial. Miniature trials have single tree plots.

Pasture Improvement, Fodder and Mulch Grass

Maize Silage Trial.—The layout and scope of the trial was described in the 1949 Annual Report where some preliminary results were also reported. Full analysis of the measurements obtained confirms the conclusions stated. The positive and linear response to phosphate on height and weight of plants is illustrated by the table below. The table also shows that similar responses were obtained from a uniformity trial planted during the following long rains season. As a consequence of late planting (22nd May, 1950) and poor rainfall the yields recorded were again low.

	DOUBLE SUPERPHOSPHATE			Significant difference
	Nil	1 cwt. per acre	2 cwt. per acre	
Mean height of plants at 31-1-50, inches	19.2	32.0	35.1	2.3
Yield of dry matter at 23-2-50, cwt. per acre . .	2.2	4.4	5.2	0.6
Residual Effects—yield of dry matter, cwt. per acre	13.6	17.7	18.6	4.6

In both seasons the total rainfall and the period of growth were less than normal: on the evidence of the trial and in these circumstances heavy dressings of superphosphates on maize as a silage crop failed to produce economic increases in yield of dry matter.

Grass and Legume Plots.—A number of grass and legume plots were established during the long rains to provide material for observation of specific suitability of local and imported grasses and legumes for the following purposes:—

Mulch grasses—ten species planted.

Ley grasses—nine species planted.

Permanent pasture grasses—eight species planted.

Legumes for fodder and cover crops—two species planted.

Lawn grasses for soil conservation usage—four species planted.

Despite poor rainfall and growing conditions the establishment was generally good and some promising types in each group have been noted.

Smaller plots containing the same range of grasses and legumes were planted at the North Kitito Sub-station.

Vlei Trial.—Investigations have shown the value of a grass mulch in coffee. The production of sufficient quantity of grass for the purpose is not possible on many estates, because the coffee occupies most of the area of the estate, and often, with the exception of vleilands, land of suitable soil and slope may be restricted to a few acres only. The heavy and impervious nature of vlei soils has prevented the greater use of vleilands for the production of mulch grass. Investigation of this aspect of mulch production was started with an exploratory trial in replicated form planted in April. Four types of mulch grasses were chosen for comparison with the following treatments:—

± Subsoiling, ± Lime at 1 ton per acre.

± Open or tied ridges of two sizes.

Some information regarding the value of these treatments is required before a full scale trial of statistical design is laid down.

RAINFALL RECORDS AT COFFEE STATIONS—1950

	A	B	C	D	E
	<i>in.</i>	<i>in.</i>	<i>in.</i>	<i>in.</i>	<i>in.</i>
January	1.43	1.93	1.27	0.49	0.08
February	0.13	0.48	0.10	0.23	0.03
March	5.41	4.76	5.93	6.52	2.37
April	8.99	9.68	10.73	9.79	4.62
May	2.67	2.92	4.40	2.66	2.13
June	0.27	0.87	0.67	0.99	7.95
July	0.53	0.20	0.43	0.23	10.12
August	2.27	1.76	2.46	0.21	3.21
September	0.35	0.38	0.41	0.00	5.09
October	0.49	2.03	0.78	0.55	5.97
November	3.21	3.50	2.65	6.46	0.54
December	0.45	0.50	1.04	2.52	0.00
Total Inches ..	26.20	29.01	30.87	30.65	42.11
Total Days ..	107	99	104	97	145

A—Coffee Research Station, Ruiru.

B—Scott Agricultural Laboratories, Nairobi.

C—Anmer Estate, Kiambu.

D—North Kitito Estate, Makuyu.

E—Kitale Experimental Station.

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ANNUAL REPORT FOR 1950 OF THE PLANT PATHOLOGIST AND PHYSIOLOGIST, COFFEE SERVICES

The main investigations carried out during the year were in relation to leaf fall and copper spraying. Other investigations included the effect of maleic hydrazide on growth and assimilation, a further inquiry into the causes of onion flavour, an investigation of the causes of "bricky" flavour, and microscopic examinations of certain warts and mottle spots on coffee cherry.

Leaf Fall and Copper Sprays

1. FIELD TRIAL OF COPPER AND NON-COPPER CONTAINING FUNGICIDES

This trial was first described in the Annual Report for 1948. Its primary aim was to find out whether leaf fall was controlled by other fungicides than those containing copper. Good evidence for this was obtained and the trial was continued as a yield trial, although not very efficiently designed for this, in order to see whether evidence of any extra tonic affects of copper sprays could be detected other than those due to the control of leaf fall.

The layout is a combination of a 6 $\times$ 6 Latin Square and a 6 plot randomized block giving 12 replications in all; there is only one tree per plot. The trial is on plot 6 at the Scott Laboratories, Nairobi (altitude 5,900 ft.), and the material is single or single two-stem grafts of the Tanganyika Drought-Resistant variety (apparently not S.L.28 as stated previously) on to French Mission rootstocks. The treatments are, as follows:—

- (1) Control unsprayed.
- (2) Copper sulphate solution watered on the ground; in the first year the precipitated copper in Burgundy mixture was injected into the trees.
- (3) 2 per cent Magadi Soda Burgundy at 1 pint per tree.
- (4) 2 per cent Carbide Bordeaux at 1 pint per tree.
- (5) "Tulisan", 2 oz. per gallon at $\frac{1}{2}$ gallon per tree.
- (6) Lime Sulphur 1 in 60 at $\frac{1}{2}$ gallon per tree.

The analyses for leaf fall during the first two years are now available, and are given in Table I. The first period of about one month shows some evidence that the copper sprays actually increased leaf fall immediately after application, an effect which is absent with the non-copper sprays. The same effect has since been observed in other experiments and under certain conditions may be of importance.

In the second column, the overall effect on the two leaf fall periods following the 1948 spraying is shown; there are highly significant depressions of leaf fall for all the sprays, the non-copper sprays being just as efficient as those containing copper. In the third column, it is seen that the effect lasted through to the second (December-January) leaf fall period.

In 1949, leaf fall was not nearly so marked as in the first year, but over the whole period, there were highly significant decreases due to both copper and non-copper sprays, and again there was no question of the copper sprays being more efficient than the non-copper, in fact the figures tend in the opposite direction. The main effect was on the first leaf fall period (29th June-28th December, 1949) but there is also evidence for a small effect on the second period (28th December, 1949-31st March, 1950).

The figures in the last column give the leaf fall over the two years. The differences between copper and non-copper sprays are seen to be extremely small. No statistical analysis has been carried out on the total figures as it was considered unnecessary.

TABLE I.—LEAF FALL PER TREE AND PERCENTAGE OF CONTROL

Treatment	10.6.48-5.7.48		15.11.48-3.2.49		10.6.48-3.2.49		29.6.49-28.12.49		28.12.49-31.3.50		29.6.49-31.3.50		Total 2 years	
Control ..	249	% 100.0	918	% 100.0	2,821	% 100.0	713	% 100.0	448	% 100.0	1,161	% 100.0	50,545	% 100.0
Watered Copper	262	105.2	953	103.9	35,741	104.2	743	104.2	459	102.4	1,202	103.5	53,188	105.2
Burgundy	303	121.7*	416	45.3	1,860	65.7†	469	65.7†	322	71.8*	791	68.1†	34,741	68.8
Bordeaux..	293	117.7	390	42.5	1,764	62.5†	548	76.8†	379	84.5	927	79.8*	35,302	69.9
"Tulisan"	246	98.8	505	55.1	1,877	66.5†	428	60.1†	337	75.2	765	65.8†	34,707	68.6
Lime Sulphur	230	92.4	523	57.1	1,880	66.6†	414	58.1†	379	84.5	793	68.3†	36,269	71.8
Significant Difference 1%	69.9		211	23.0	418.9	14.8	162	22.7	127	28.3	236	20.3		
Significant Difference 5%	52.4		158	17.2	314.1	11.1	122	17.1	95	21.2	177	15.2		
Coefficient of Variation..	24.2		31.13		17.43		26.86		29.95		22.95			

*—Significant at the 5 per cent level.

†—Significant at the 1 per cent level.

As the results were considered to be sufficient evidence for the control of leaf fall by non-copper fungicides, weekly counts of leaves falling from the trees were discontinued in 1950, but in order to keep a check on the progress of leaf fall, loss of leaf from a single branch chosen on each tree at random was followed. Further, as the experiment had now to be run from Ruiru, only one instead of two sprayings was applied, this being on 2nd June. Copper sulphate was watered on on 15th June. It is probable that spraying was rather late as growth occurred as a very short flush due to the poorness of the long rains, and had already decreased to quite a low level when the sprays were applied. The branch leaf fall records show that the sprays were not as effective in controlling leaf fall this year as in previous years and there appears to be differential effects as between the copper and non-copper sprays. Each pair of treatments: control and copper watered on, "Tulisan" and Lime Sulphur, Bordeaux and Burgundy show essentially similar graphs, but considerable differences occur between the pairs. Statistical analysis presents difficulties and has not been attempted, but it would seem justifiable to infer real differences in effects. The control and watered copper show the usual two leaf-fall periods, the earlier having this year three well marked peaks. The Lime Sulphur and "Tulisan" show somewhat reduced leaf fall during the first peak, but thereafter increased fall over control and this was very marked in the latter treatment. The Burgundy and Bordeaux show markedly reduced leaf fall compared with control during the first peak, but ascend to markedly increased fall in the third during October to November. A further complicating factor this year has been a bad attack of mealy bug which started about June and was not under control until early in 1951. This undoubtedly caused considerable additional leaf fall to that normally experienced and may be the reason for the extra leaf fall which occurred in all sprayed treatments, there being more leaf on the sprayed trees which could be caused to be shed by the mealy bug.

Scores made by eye judgment at the end of the year on intensity of mealy bug attack showed "Tulisan" and Bordeaux worst, Burgundy a little less, whereas control, watered copper and Lime Sulphur had it least. This agrees with the marked increased fall in the three first treatments following the period of decreased fall.

Scores for depth of greenness of foliage in mid-February once again showed an effect of watered copper. Leaf density at this time was highest in the non-copper sprayed treatments.

Although observations of leaf fall have been continued, the emphasis of interest in this experiment is now on whether there will be increases of yield from the non-copper treatments in line with those expected from the copper sprays. Unfortunately, the experiment was not really designed to detect yield differences, and the coefficients of variation are inclined to be high when dealing with yields and tend to obscure possible differences. Further, in the first and second years, only cherry weight were recorded from individual plots, though in the second, clean coffee weights were obtained by pooling the cherry from each treatment and processing by the wet method. This year, after weighing the cherry, it was allowed to dry on trays in the sun, each subsequent picking being pooled for each plot. At the end of the season, the total crop for each plot was thus available as "mbuni". It was weighed and a 500 gram sample taken and hulled and the weight of the clean coffee resulting obtained. The amount of clean coffee per plot could thus be calculated and a full analysis carried out.

Table II gives the cherry weight and clean coffee analyses up to date. Over the three years, there has been no evidence for increased yields, except for Burgundy in the first year. On the other hand, there appears to have been a distinct depression of yield due to Bordeaux in the third year. It is possible that the heavy attack of mealy bug on trees of this treatment may have been in part responsible for this affect. The lack of increased yield from copper spraying is surprising in view of the results of other field trials, especially as,

over the four-year period differences of yield of over 26.6 per cent should have been detected and copper spraying normally leads to much greater responses than this. Certain circumstances which may have been contributory to this result are as follows: Firstly, in the first year, crop was reduced so as not to have any spurious affects of over-cropping on leaf fall and so mask the effect of the sprays. The crop was therefore likely to be insensitive to spraying and in addition, spraying does not normally affect the crop to a large extent in the first year. In the second year, adverse climate led to a small crop, which was again unlikely to reflect to any extent any beneficial effects of spraying. In the third year, the bad attack of mealy bug seriously upset and reduced the crop on many trees.

2. OBSERVATIONS ON LEAF SHEDDING, YELLOW SPOTTING, BARK AND LEAF MATURATION.

This series of observations was described in last year's annual report. They were concluded at the end of September.

A well-marked leaf shedding period occurred from mid-January to March and the main shedding period persisted from June to the end of the observations. Shedding was rather more active during this period than it had been the previous year. A comparison with growth rate graphs from the same trees shows the shedding curve to be a fairly precise mirror-image of the former.

Whereas the average age of shed leaves last year was between 30-36 weeks, it has been considerably higher all the time this year. During the latter half of the short rains, minimum shedding period of 1949, it had risen to 40-42 weeks and during the January to March shedding period and the long rains minimum shedding period, it climbed somewhat irregularly to a maximum of nearly 56 weeks. It then fell slowly and somewhat irregularly throughout the main shedding period to between 38 and 40 weeks towards its end. Although this is considerably higher than for the same period the previous year, it does not seem necessary to modify the general conclusion drawn then that shedding age is lower in the main shedding period than in the January-February period. In fact it supports the conclusion drawn then that shedding periods are not due primarily to the varying supply of leaf at a given age, but are probably due to the physiological state of the bush at these times. In addition the fact that slight decreases in shedding were reflected by slight increase in shedding age noted last year was confirmed this year. The age at which leaves are shed is probably mainly controlled by the length of time which elapses between their formation, their passing of a critical age which may be in the region of 28 weeks, and their meeting with a period during which conditions are conducive to shedding. A further factor may be the intensity of the shedding stimulus.

Over the entire period of observation, the average age at which yellow spotting was first observed was about 20 weeks, and over any fortnightly period it varied from 14 to 28 weeks. In July, 1949, it was 20½ weeks. It descended to 18 weeks in August and then ascended to the maximum of just under 28 weeks in December to descend rapidly to 15½ weeks in January. From then on it maintained a level of about 18 weeks around which it fluctuated without any marked trend to the end of the period of observation. It is a little difficult to be sure of the lowest age that any individual leaf first shows yellow spotting as it is difficult to be certain in the early stages, whether a given spot is a true "yellow" spot or merely some other type of blemish. However, quite frequent cases of leaves only about 6 weeks old developing yellow spotting have been observed, and 10 weeks is very frequent. As it is now definitely established that yellow spots are of fungal origin, some idea of the times of infection may be obtained. Minimum ages from mid-August to December, 1949, increased at the rate of approximately two weeks at each observation suggesting the last date of possible infection to have been the end of the long rains about mid-May. On 16th December, the minimum age showed a sudden drop to 14. This

TABLE II

Treatment	CHERRY WEIGHTS IN LB. PER TREE					CLEAN COFFEE IN LB. PER TREE								
	1948		1949		1950		3 years (1)		1949		1950		2 years	
	%		%		%		%		%		%		%	
Control ..	5.23	100.0	3.86	100.0	16.36	100.0	26.30	100.0	0.35	100.0	3.03	100.0	3.38	100.0
Watered Copper ..	6.24	119.3	3.50	90.7	16.25	99.4	26.00	98.9	0.33	94.4	3.02	99.6	3.35	99.1
Burgundy ..	10.38	198.5*	4.10	106.2	14.68	89.8	28.76	109.4	0.31	88.6	2.57	84.7	2.88	85.3
Bordeaux..	5.56	106.4	4.93	127.8	7.96	48.7†	18.00	68.4	0.34	97.2	1.37	45.1	1.71	50.6
"Tulisan" ..	7.41	141.7	3.07	79.5	16.98	103.8	27.47	104.5	0.29	83.0	3.23	106.6	3.52	104.2
Lime Sulphur ..	7.42	141.8	3.25	84.2	14.26	87.2	24.93	94.8	0.28	80.0	2.57	84.8	2.85	84.4
Significant Difference 1%	5.46	104.4	2.74	70.1	7.40	45.2	7.40	26.6			1.48	48.8		
Significant Difference 5%	4.09	178.2	2.05	53.1	5.55	39.3	9.87	37.5			1.12	36.5		
Coefficient of Variation ..	70.9%		66.2%		46.9%		35.7%				51.4%			

(1) The figures for the three years given do not add up exactly to the figures in this column owing to an erroneous interchange of treatments for which compensations have been made. This also accounts for small discrepancies with the figures given last year.

*—significant at the 1 per cent point.

†—significant at the 5 per cent point.

relates to leaf which had been formed at the commencement of the short rains and was presumably infected during them. By 14th April, it was $11\frac{1}{2}$ weeks, i.e. leaf formed at the end of the short rains growth period in January, and then fell suddenly to 5-7, i.e. leaf formed at the beginning of the long rains. It then rose to the region 10-12 for the rest of the period of observation. This covers the leaf formed during the long rains.

The numbers of leaves developing "yellow" spotting for the first time show peaks in October, January, April, July and September. These peaks, when the average age the leaves develop yellow spotting at these times is taken into account, agree approximately with the distribution of the rains.

The average age at which severe yellow spotting was first seen ranged from 21 weeks to 43 weeks. It fell from 41 weeks in July, 1949, to 23 in August-September, and then rose somewhat irregularly to a maximum of 43 weeks in March, 1950. The record following this point is incomplete as very few leaves developed severe yellow spotting at this time, but following this there was an irregular downward drift to about $24\frac{1}{2}$ weeks at the end of September. In general, the curve seems to approximate to that of the first appearance of yellow spotting with a delay of 6 to 12 weeks.

Peaks of development of severe spotting occur at about the same times as shown by the curves for the first signs of yellow spotting. As the time interval between the peaks on the latter is about 12 weeks, it would seem probable that those on the former correspond to the previous ones on the latter, and in fact the marked April peak on the first signs of yellow spotting curve is accompanied by a very small peak on the severe spotting curve, but there is a marked peak in July-August on the latter, some 12-14 weeks later.

The general conclusions appear to be that leaves become infected at a relatively early age, possibly within the first ten weeks. It takes from about 5 to 25 weeks for this infection to become first visible and severe symptoms may be developed between 16 to 40 weeks. The upper range is perhaps rather doubtful as these figures may be due to infection of relatively old leaves. The possibility that infection might only occur at a relatively early age must be borne in mind in future when attempting to reproduce the symptoms by artificial inoculation.

The average age at which the bark turns brown has now been calculated for the duration of the experiment and shows a fairly smooth curve starting at 43 weeks in July, 1949, and descending to a minimum of $35\frac{1}{2}$ weeks at the beginning of September, and climbing to just over 44 weeks in December-January. It remains level until the beginning of March when it climbs again to a maximum of nearly 56 weeks in June, 1950, from where it descends to just over 44 weeks at the end of September. It is thus rather similar to the general form of the age of shed leaf curve and this resemblance suggests some relation between the two. In consequence in another experiment, the effect of spraying on age of bark ripening has been recorded. There is also a general resemblance between the shedding curves and the rate of brown bark maturation curve. It is a process which appears to be maximal following the growth periods. However, the resemblance is not precise since whereas the maximum rate of ripening was at the beginning of the shedding periods in July-November, 1949, and January-February, 1950, in the June-October period of 1950, it was towards the end in August. This change in behaviour may once again be due to the different timing of the growth periods in the two years.

During 1950, it has been possible to obtain similar data for grey bark ripening, as the period the branches had been recorded was now long enough. In January the average age was about 54 weeks and it ascended gradually to 61 weeks in April. It then fell slightly to rise again to a maximum of nearly 70 weeks in September. The position of grey bark thus marks very approximately, wood a little over a year old. As with brown maturation, the rate of grey bark progression along the branch is subject to considerable fluctuation.

It was moderate in January and February, minimal in March and ascended rapidly to a peak in April-May, during the growth period. It descended to low values during June to mid-September and then started climbing again. The moderate values in January-February are somewhat puzzling, but apart from this, it would appear that the greying stage of maturation normally occurs during the growth periods and is relatively static when growth ceases.

During the entire period of observation leaf maturation varied from an average of 9 weeks to 20 weeks. It was somewhat irregular but in general, leaves matured at the youngest at the conclusion of growth periods and at the oldest just before its onset. As regards number of leaves maturing in unit time, this reached a very marked peak in January following the short rains although there had not been a very marked growth period. Maturation following the long rains reached a peak but this was much less marked.

3. THE EFFECT OF COPPER SPRAYING AT DIFFERENT TIMES OF THE YEAR ON LEAF SHEDDING.

This experiment, which was started in October, 1949, at the Scott Laboratories, was described in the last annual report. Eighty-four branches were recorded for leaf age and every two months, a set of seven branches was sprayed. The leaf fall from all the branches was recorded. The ultimate aim is to obtain the effect of spraying on leaf age when shed, but this data cannot yet be calculated as the experiment will not be concluded until the short rains 1951, when all sprayed leaves are expected to have been shed. In the mean time, however, the effects on rate of leaf shedding can be observed. The spray applied in November appeared to have little effect on rate of leaf fall as compared to the control branches. Spraying in January caused heavy leaf fall and stunting of the leaves, from which the branches took a considerable time to recover, new growth also being stunted for several months following the spraying. Spraying early in the rains in March controlled the early part of the main leaf fall period only. A May spray controlled leaf fall in this period well, but the July spray had little beneficial effect. Sprays in September and November were also ineffective. To get maximum control of leaf fall from a single spray, it would seem that, at the Scott Laboratories, application should be made half to three-quarters of the way through the long rains growing period. With some spraying dates, the immediate effect is to cause extra leaf shedding (compare the effect of copper spraying noted in the first month in the copper v. non-copper spraying experiment described above). The effect seems to be most noticeable when the sprays are applied in a shedding period; it was particularly marked with the January spray. During the close observation of individual leaves which this experiment entails, it was noticed that a type of yellow spot rather similar to that discussed above was often abundant on sprayed leaves, but in this case, there is no swelling of the mesophyll tissue and the centre often becomes necrotic. There is no doubt that this is a type of spray damage and it has now been recognized to be of quite frequent occurrence on coffee sprayed in normal practice on estates. It was particularly bad in the case of the January spraying and it may be connected with the extra leaf fall mentioned above.

Investigations on time of spraying have also been carried out at Solai and I have to thank Mr. Geoffrey Ireland of Milmet Estate for his co-operation and hospitality which have made this project possible. It was early realized that as the growth cycle in Solai was likely to differ fundamentally from that in the main East Rift area, and since leaf fall has been shown to be closely related to the growth cycle, the time to apply sprays might be different from those applying in the latter. As branches whose history was known were not available, it was not possible to use the same methods as at the Scott Laboratories. Instead, the leaf fall from individual branches was recorded. The observations were started on 21st March when 18 branches were chosen at random as controls on three multiple-stem trees with three heads each, two branches per head. Eighteen further branches adjacent to these were chosen and sprayed

with Perenox. Two months later, a further 18 branches adjacent to the controls were chosen and sprayed, and this process continued until there were six sets of sprayed branches. Leaf fall from the sprayed portions of the branches was followed and also from the corresponding portions of the control branches. Loss of leaf from those portions of the sprayed branches formed after the spraying was not actually recorded, but the shedding curves were reconstructed with the aid of the control branch records for which shedding was followed for all portions.

On the control branches there was hardly any shedding from June to September, in sharp contrast with the position in the main East Rift areas and this is presumably related to the single growth period (see the section of this report on growth). Leaf fall commenced in September and became maximal in December, to drop to a very low value with the onset of the rains. Spraying in mid-March controlled very little of this leaf fall, whereas a mid-May spray reduced leaf fall by about half, the earlier leaf fall being most affected. A spray in mid-June was as effective but the middle of the leaf fall was most reduced, whereas a September spray dealt with the last half of the leaf fall. Sprays in November and January only affected the last half and to a minor degree. It would appear that the timing of spraying in this area can be less precise than in the East Rift coffee. Probably the first half of July, i.e. about half way through the growth period would be most effective, though any time in May to July should give good results.

Since the growth cycle in Solai appears similar to those holding in the West Rift areas generally, until further information is available, similar timing of spraying should be followed in these areas.

Growth Control by Maleic Hydrazide

It would seem probable that in many West Rift areas shy bearing, berry fall and other difficulties may be related to the fact that the growing season lasts for most of the year. The starch produced by photosynthesis may be used immediately for fresh vegetative growth instead of accumulating to a sufficient extent to supply the needs of developing inflorescences. Maleic hydrazide has been reported* to inhibit vegetative growth on other plants without having other adverse effects. It seemed worth while to see whether it would also inhibit coffee growth, and since to be of use for the West Rift conditions, it must not affect assimilation, this was also tested.

As a preliminary test, a block of six multiple stem trees was chosen and three trees sprayed at random with a 0.2 per cent maleic hydrazide spray to run-off on 29th November. Two branches per head, one in the upper half and one in the lower half were chosen at random and their extension growth recorded. Every month assimilation was measured by the leaf punch method, correcting for change of area by obtaining the weights of the discs after hydrolysis under pressure with dilute hydrochloric acid. Four mature leaves per branch were used for the measurements, discs being punched from opposite halves of the leaves at dawn and dusk. The branches bearing these leaves were chosen at random from the upper and lower half of each head.

No effects on flowering or morphology were noticed. Growth was somewhat less throughout, but the decrease was too slight and the replication insufficient to make this significant. There was no evidence for any marked effect on assimilation and the general trend appeared to be a tendency for higher dry matter accumulation in sprayed leaves which may indicate reduced translocation from the leaf.

In a second experiment, three multiple stem trees in a row were used. One branch per head (giving three per tree) was chosen at random as a control and three similar neighbouring branches selected which were sprayed on 29th November, with 0.1 per cent, 0.2 per cent and 0.3 per cent maleic hydrazide solution. The extension growth of these branches was measured at fortnightly intervals.

* Science, 109 588, 1949.

At the end of the short rains growth in mid-January, the total growth in millimetres for all the branches in each treatment were as follows:—

0.1 per cent	100
0.2 per cent	118
0.3 per cent	131
Control	131

There was thus little evidence for growth reduction except with the lowest concentration.

Thus in both experiments the evidence does not suggest more than a slight growth reduction. A repetition of these experiments using the more soluble diethanolamine salt or maleic hydrazide combined with a wetter are planned.

I have to thank the local representatives of Imperial Chemical Industries for the supply free of charge of the maleic hydrazide used in these experiments.

Taints in Coffee Liquor

An account of the investigation of the causes of "bricky" flavour has already been published in the Coffee Board Bulletin (April, 1951). This investigation took the form of two circular letters to certain coffee planters who had received reports of a "bricky" flavour in their coffee. The results were analysed and it was concluded that there was a strong case for considering treatment with insecticides containing benzene hexachloride to be the cause of the trouble. Wettable sprays seemed to be the main offenders, but banding with wetttable or dust products such as Agrocides 7 and 3 also appeared to have been implicated in certain cases. A field experiment is to be laid down in co-operation with African Explosives and Chemical Industries to test the effect on liquor of a number of different BHC compounds and treatments.

A similar circular letter to planters who had had reports of onion flavour in the liquor was also sent out. The results have been published in Coffee Board Bulletin for March, 1951. It appeared that neither insecticides nor fungicides were likely to be implicated and there was some evidence for a connexion with prolonged contact of pulped coffee with water, such as sometimes occurs when a prewashing channel is employed. This confirms one of the conclusions arrived at last year in the investigations described in the annual report.

Growth Recording

At the Scott Laboratories, Kabete, the short rains growth period of 1949 persisted through January, but growth fell to a very low level in February, by which time the electrical soil moisture measurements showed the soil to have been completely exhausted of available moisture. The growth on the watered trees at this time ascended to a maximum. With the onset of the long rains in March, there was a rapid rise to a peak in April, when growth was at a greater rate than on the watered trees. The growth of all trees then fell off very rapidly in May to a very low level. The soil moisture readings do not suggest that soil moisture was the limiting factor causing this fall, since in May there was a maximum of available moisture and drying out did not commence until June and was still not complete by the end of August, when considerable rain fell, causing the available moisture to increase again. This was short-lived, and by the end of September there was no available moisture in the first block of coffee. The long rains were very poor and on one profile there was no appreciable wetting below 6 ft. and on another below 9 ft. On the other two, which were adjacent to the watered area, the whole profile was wetted. The short rains were also very poor and in none of the profiles was their effect felt below one foot. In the latter two, moisture was however still available at depth as the deeper regions had not dried out completely before the advent of the rains, though they continued to dry throughout their duration. Growth increased slightly but the response was very poor. The watered trees showed an even poorer response than the watered, but they were carrying a very heavy crop.

In view of the relation to leaf fall, growth records have been kept at Solai on Milmet Estate. A block of six trees was chosen and three of these at random were kept stripped of crop. Measurements were taken every two months. On cropping trees, growth ascended to a marked maximum in April and descended to practically nil in December-February. There was a small trough in August, but nothing comparable to the marked minimum growth period at this time at the Scott Laboratories. This appears to be connected with developing crop as it is absent from stripped trees.

Miscellaneous Investigations

At the end of November, peculiar small warty or blister-like excrescences were noticed to have developed on berries approaching maturity, on Kenya Selected trees used for growth records on plot 10 at the Scott Laboratories. In general appearance they were reminiscent of the surface appearance of severe yellow spots on leaves, but naturally were not translucent. Their structure was investigated by cutting sections in paraffin wax using the tertiary Butyl alcohol technique and staining using the Margolena differential method. The cells at a depth of three or four layers from the surface of the blister were found to be swollen. Usually from the margin of the blister, abundant mycelium could be seen penetrating obliquely from the epidermis and just reaching the enlarged cells. Shortly below the apparent point of invasion, abundant mycelium was found and at this point, cell disintegration had occurred. In some slides, an external dark inflated body (possibly an appressorium) was seen sending hyphae in the host tissue. The whole appearance is similar to the leaf yellow or "weak" spots and may be due to the same fungus.

Mottled areas on ripening coffee cherries have also been sectioned and stained using the same techniques and it would appear that these are also associated with fungal invasion.

A peculiar die-back was noticed on Gethumbwini Estate, Thika in June. Instead of the die-back starting by the death of the terminal region, a portion of the branch one to several nodes away from the tip of the branch died and turned brown. Both cropping and non-cropping branches were affected as well as shaded and unshaded trees, though it was worst on a group of trees fairly heavily shaded. The affected trees were quite sporadic. Tests for starch and nitrates showed adequate supplies available and the causes of the die-back remain a mystery.

A case of unthriftiness of an area of some 200 trees on Oaklands Estate was investigated in August. The trees were found to be growing in a slight depression. The soil was rather shallow (8 ft. at the centre) and loose granular murram was present at 2 ft. to 3 ft. The case is very similar to that investigated on Mchana Estate in 1945 (v. Annual Report for that year).

A seedling disease, causing collar rot at about ground level was sent in from Nyeri in February. Although there was abundant evidence of fungal attack and the symptoms resembled those described for *Rhizoctonia solani* Kuehn, no definite pathogen was isolated.

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ANNUAL REPORT OF THE AGRICULTURAL CHEMIST (COFFEE CHEMIST) FOR 1950

A brief summary of the progress of experimental work in soil physics and soil fertility at the Coffee Research Station is given below. As in previous years, the field experiments on soil fertility have been conducted jointly with the Agricultural Officer.

Cultivation Trial

This split-plot 3 by 3 by 3 by 3 trial of implements, depths and weed control policies has been described in earlier Annual Reports (1947 and 1948). The measurements of crop and soil structure continue to show opposing trends. Clean weeding continues to give important and highly significant increases in crop yield, while at the same time the pore space and permeability of the cultivated soils shows a progressive decline. The failure of the crumb structure estimations, by either wet or dry sieving, to give any indication of the air-space, or permeability of topsoil as measured on soil cores, casts considerable doubt on the value of soil sieving for this red lateritic volcanic soil.

CULTIVATION TRIAL—FOUR YEARS OF CROP YIELDS

(Condensed to a two-way table)

Yields as lb. fresh cherry

	Forked Hand- jembe	Tractor Disc	Tractor Plough	Totals for Weed Control
Clean weeded—				
1947	6,099	5,826	5,331	
1948	4,019	2,491	2,537	
1949	6,217	5,301	5,974	
1950	3,754	2,397	2,822	
Four year Totals ..	20,089	16,015	16,664	52,768
Slashed (during rains)—				
1947	5,240	5,286	5,650	
1948	1,604	2,041	1,833	
1949	4,312	3,935	5,131	
1950	1,452	1,120	1,525	
Four year Totals	12,608	12,382	14,139	39,129
Tall weeds (during rains)—				
1947	5,009	5,806	5,728	
1948	1,213	1,349	1,292	
1949	4,001	3,936	4,089	
1950	1,489	1,050	1,403	
Four year Totals ..	11,712	12,141	12,512	36,365
Totals for Implements ..	44,409	40,538	43,315	

Significant differences. (Less than 1 in 100 chances of confusion with error.)
For the nine four-year totals: 2,083 lb. For the marginal totals 3,608 lb.

Summary of Yield Results

Total yields of main treatments for four seasons (1947-50 inclusive) expressed as cwt. clean coffee per acre.

Type of Implement

Hand-fork (jembe) ..	19.89 cwt.	Both plough and hand-jembe were significantly better than discing. When used frequently, for clean weeding, the hand-jembe was significantly better than plough or disc.
Tractor disc	18.15 cwt.	
Tractor plough .. .	19.40 cwt.	

Depth of Cultivation

Shallow only (2-in.-3-in.)	18.47 cwt.	One or more deep cultivations showed significant yield increases with the hand-jembe but had no effect with disc or plough.
Shallow plus once deep	19.15 cwt.	
Deep only (5-in.-6-in.)	19.82 cwt.	

Control of Weeds During Rains

Clean weeded	23.63 cwt.	These effects are highly significant and show the adverse effect of weed competition during the rains, even when slashed.
Slashed	17.52 cwt.	
Tall weeds	16.29 cwt.	

Subsoiling (Three seasons only)

No subsoiling	19.23 cwt.	Subsoiling had no significant effect on yield either in any year, or over the whole period.
Biennial subsoiling ..	18.84 cwt.	
Annual subsoiling ..	19.38 cwt.	

EFFECT OF BOMA MANURE

In search of information on the effects of "boma manure" which had failed to raise yields in earlier and smaller experiments, the 81 plots of the cultivation trial were split for comparison of one 4-gallon tin per tree, per year against nil. This dressing of 3-4 tons per acre is equivalent to 7-8 tons of dung at the moisture contents prevailing in temperate agriculture. Although small, it exceeds the average annual dressing achieved in commercial practice. The manure is collected from open cattle *bomas* on the dry plains, and large sums are expended annually by the coffee industry on the purchase and transport of this material. By sub-plot comparison, yield effects are very thoroughly tested, while observations on weed growth, weed competition and effect of depth of incorporation of manure are made possible. The manure has been applied for four years, 1947-1950, but sub-plot yields have been taken only for three years, 1948-1950.

Results.—3-year mean yields as cwt. clean coffee per acre:—

With manure, 5.88 cwt. No manure, 5.81 cwt.

The difference has been negligible, both statistically and economically, in each year and over the three years. Weed growth is noticeably increased by the manure, but the effect does not extend to the coffee.

Analyses of the manure applied have been based on extensive samplings in each year. There have been wide variations in the proportions of water and soil in the material as purchased, e.g. water from 12 per cent to 30 per cent and earth from 50 per cent to 75 per cent. Of the oven-dry matter, less than 15 per cent may be oxidizable organic matter. The dry matter contains about two per cent of nitrogen, but only 0.5 per cent of phosphate (as P_2O_5).

It appears probable that the expenditure incurred by planters for this material is uneconomic.

Soil Structure Measurements of Cultivation Effects

As in previous years, all 27 cultivation treatment combinations have been measured by sampling those plots which are not subsoiled. Separate measurements of the subsoiling operation have also been made. The cultivation treatments were tested by measurements on 81 Veihmeyer sleeved soil cores to determine volume weights, total pore-space, distribution of pore-space by tension table measurements

of water content at nil, 50 and 100 cms. tension and finally percolation rates under 1 cm. static head. Both wet and dry soil sieving of three soil samples taken close to each core sample have permitted direct comparisons.

The progressive decline of soil structure under continuous cultivation is best illustrated by the percolation figure set out below. Percolation measurements were begun only in October, 1949. Care has been taken to maintain a uniform technique of handling samples, to take the cores under similar soil moisture conditions, and to do all the percolation measurements on cores brought to equilibrium at 100 cms. tension, so that results for successive seasons are strictly comparable. Each figure is the mean for nine soil cores.

JANUARY 1951 PERCOLATION RATES IN INCHES PER HOUR

Weeding Treatments	Hand Fork (Jembe)	Tractor Disc	Tractor Plough	Means for Weed Treatments
Clean weeded	9.6	11.0	8.8	9.8
Slashed Weeds	12.4	11.7	6.9	10.3
Tall. Weeds	14.9	14.4	17.4	15.6
Means for Implements ...	12.3	12.4	11.0	

Least significant difference for means—5.6 at P_{05}

In each year the tall weed growth has given percolation rates significantly better than clean weeding. In October, 1949, the hand-forking gave percolation rates significantly better than the tractor implements, but this difference did not persist 14 months later.

Coffee Manurial Trial I

Brief descriptions and annual comment on this trial have appeared in previous annual reports. Four annual crops have now been taken, and the problems of biennial bearing thus largely overcome. The results have therefore been examined in more detail this year, and are summarized below at some length.

The experiment measures yield responses to nitrogen, as sulphate of ammonia, to phosphates of local origin, both as soda-phosphate and Uganda rock phosphate, and to organic matter. The latter was originally described as "compost". It is made on the estate in covered night *bomas* by yarding cattle on Napier grass. The trodden material is turned across a succession of concrete hillside stages of modern design, and the result approximates to "FYM". It is very different to the dry-plains "*boma* manure". As applied, typical analyses gave water 40 per cent to 50 per cent, the dry matter containing 2.5 per cent nitrogen and 0.8 of phosphate (as P_2O_5). One 4-gallon tin (*debbe*) per tree is equivalent to between $3\frac{1}{2}$ and $4\frac{1}{2}$ tons per acre, according to moisture content.

The levels are nil, once and twice the maximum annual dressings used in local commercial practice. The trial was designed after detailed study of yield variability of coffee and the results of earlier small yield trials and observation plots. Replication is high enough to establish with confidence the smallest yield responses of economic importance.

Four replications of the 3 by 3 by 3 factorial set of treatments are grouped by balanced partial confounding into twelve blocks of nine plots. There are twenty trees per plot, surrounded by single guard rows. The coffee is "10 by 10" single stem. Where cattle manure and phosphates are given to the same plots, the phosphatic fertilizers are added to the manure while turning the heaps, several weeks before application.

TOTAL 4-YEAR YIELDS FOR MAIN TREATMENT FACTORS
(in lb. cherry)

Annual Dressing	Yields	Annual Dressing	Yields	Annual Dressing	Yields
No nitrogen ..	13,505	No phosphates	13,619	No cattle manure	13,922
1 cwt./acre S of A	13,109	2 cwt./acre Soda Phosphate ..	13,604	3-4 tons/acre (1 debbe) ...	13,461
2 cwt./acre S of A	14,301	3½ cwt./acre U.R.P. ..	13,692	4-8 tons/acre (2 debbies) ..	13,531

Least sig. difference at 5 per cent level: 982 lb.

There has been no effect from either cattle manure or phosphate. The first hundredweight of nitrogen has given no sign of effect, while the second hundredweight has given a small increase in two years out of four, which is not quite significant for the 4-year total. The coefficient of variation is 15.3 per cent and the experiment could detect differences of 7.2 per cent of the yield. Of the several interactions, only one reached significance at the 5 per cent level.

	No. N	1 cwt. S of A	2 cwt. S of A	Differences
No Manure ...	4867	4345	4710	$n_0c_0 - n_0c_2 = 686^*$ (14.1 per cent)
1 Debbe per tree	4456	4241	4764	$n_2c_2 - n_0c_2 = 646^*$
2 Debbies per tree	4181	4523	4827	$n_0c_0 - n_1c_1 = 626^*$ (12.9 per cent)

*Least Significant Difference at 5 per cent level: 567 lb.

i.e. The manure alone reduced crop by 14 per cent, the nitrogen alone had no effect on the crop. The first level of manure and nitrogen, given together, reduced crop by 12.9 per cent. The double dressing of nitrogen overcame the depression caused by the double dressing of manure, but the combined dressing did not raise the yield above that of the untreated coffee.

While the clean coffee ratio was measured by several hundred samples in each year, the treatment yields and interactions in terms of clean coffee are known with less precision than as cherry yields, whose statistical analysis is reported above. The conversion to clean coffee serves to emphasize the lack of response shown in the cherry yields.

A summary of the clean coffee yields is given below in the terms familiar to the industry:—

4-YEAR TOTAL YIELDS AS HUNDREDWEIGHTS OF CLEAN COFFEE PER ACRE

Year	n_0	n_1	n_2	p_0	p_1	p_2	c_0	c_1	c_2
1947	5.53	5.32	5.52	5.46	5.40	5.51	5.51	5.47	5.40
1948	1.50	1.51	1.68	1.51	1.63	1.56	1.62	1.48	1.59
1949	2.05	1.89	2.20	2.01	1.88	2.26	2.07	2.05	2.03
1950	2.71	2.85	2.72	3.18	2.76	2.35	2.70	2.62	2.96
4 year Total ..	11.79	11.57	12.12	12.16	11.67	11.68	11.90	11.62	11.98
Percent of Control	100%	98%	103%	100%	96%	96%	100%	98%	100%

INTERIM CONCLUSIONS

These results confirm the indications of smaller trials that on red volcanic soil the coffee crop does not respond to phosphates in any of the variables measured (yield, earliness of crop, size of bean, raw, roast or liquor classification). There has been no response to cattle manure, but there is evidence that the crop is sensitive to nitrogen supplies. While 1 cwt. per acre is definitely too low, the 2 cwt. sulphate of ammonia dressing may still be too small. This suggestion is supported by the results of the small supplementary trial reported below.

Manurial Trial II

Sampling, in this small trial, was adequate for analysis of yields in terms of clean coffee. The first season's results are suggestive of effects from the 4-cwt. dressing of sulphate of ammonia.

	NO NITROGEN		4 CWT./ACRE S. OF A.		Means
	No manure	14 tons/acre (4 debbies)	No manure	14 tons/acre (4 debbies)	
No Phos- phates ...	3.64	2.89	5.18	4.87	4.14
2 cwt./acre Double Su- pers ...	2.65	4.33	4.12	3.00	3.52
Means ..	3.38		4.29		Least Signi- ficant Differ- ence for means 1.02 cwt./acre.
	Manure 3.77		No Manure 3.89		

Considerations of staff and labour made a small trial necessary. Two replications of the 2 by 2 by 2 treatments proved inadequate to overcome the variability of coffee, and the trial was able to detect only differences exceeding 26.6 per cent of the mean yield. There was an apparent overall increase of 52 per cent from the nitrogen, a decrease of 17 per cent from the heavy dressing of superphosphate, and no effect from the cattle manure. The nitrogen gave a significant increase of 54 per cent when used without phosphates, but the experiment was not accurate enough to confirm the depression due to phosphates, while the response to nitrogen was significant only in their absence.

The inherent biennial bearing habits of coffee make a single year's yield responses unreliable, but the experiment will be continued with interest.

The Mulching and Soil Regeneration Trial

This is a study of the effects of mulches, in combination with fertilizers and manures, on poor coffee on a badly eroded slope, for comparison with regeneration by replanting coffee after a Napier grass ley.

The intention to include nitrogen treatments was defeated by the late arrival of imported fertilizers, and the trial was conducted as eight replications of the combinations of four mulching treatments with and without cattle manure.

Mulches were applied at the optimum times. The cattle manure was the material described above (Manurial Trial I); it was disced in immediately before the mulches were applied.

YIELDS IN CWT. CLEAN COFFEE PER ACRE

(Significant Differences at $P_{.05}$ 0.47 cwt., and at $P_{.01}$ 0.62 cwt.)

	No Mulch	All row mulch before rains (March)	Alternate row mulch before rains (March)	All row mulch after rains (May)	Mean Yields for Manuring (Sig. Diff. 0.23 cwt.)
No Cattle Manure ...	0.61	1.49	1.05	0.55	0.92
32 tons/acre Cattle Manure (1 debbe) ..	0.91	1.54	1.13	0.86	1.11
Mean Yields (Sig. Diff. 0.33 cwt.)	0.76	1.52	1.09	0.71	

The yields were poor and variable, but the increase due to alternate row mulching before rains was significant, and the further increase due to all row mulching was also significant, the crop being exactly doubled by the full mulching.

There was an interesting and consistent apparent response to cattle manure which just failed to reach statistical significance. This contrasts with the lack of response to identical dressing on the more normal top-soil of Manuarial Trial I. There is no suggestion that the combination of mulch and manure was better, in this first year, than the two given separately.

The complete lack of response to post rains all row mulch, even in a dry year, emphasizes the results of soil moisture studies, in that the benefit of a grass mulch is due mainly to the increased penetration of the monsoon-type rainfall when received by a mulched surface. The post-rains protection from evaporation is much less important, although substantial and statistically significant improvements in soil structure under mulches have been measured on this experiment. These may well produce an improvement in the 1951 crop as the result of post-rains mulching in 1950.

H. C. PEREIRA,
Agricultural Chemist (Coffee Services).

ANNUAL REPORT OF THE SENIOR PASTURE RESEARCH OFFICER, 1950

The Plan of Work

Survey of the vegetation of Kenya has been carried out over a considerable number of years, an ecological classification has been provided and the regions have been roughly mapped. This work was undertaken with a view to providing a basis for the research plan in a country in which marked contrasts of climate from one region to another are induced by elevation and aspect of the land. The plan envisaged has always consisted essentially of the establishment of regional research stations in representative parts of the five main ecological zones which have been recognized.

With the provision of additional staff, it is proposed to set up three of these main stations to serve the ecological regions which occur in the highland portion of the country situated to the south-west. The work of these stations will deal with grassland problems under the two main sections of (a) management of natural pasture, and (b) establishment and management of pasture leys (where appropriate to the conditions of the region). It is proposed, eventually, to place each of these regional stations in the charge of a Pasture Research Officer, but some delay has been experienced in obtaining suitable sites and this has necessitated the temporary posting of one of the officers to the existing agricultural station at Ol Joro Orok, and another to the Kabete Experimental Station. The first regional station is in the course of establishment at Kitale, where a Soil Conservation Service farm has been taken over, and the site for a second station has been selected at Molo.

The five ecological regions defined by the major plant communities of the country are given below. The plan provides for a limited number of sub-stations to be attached to each main regional station in order to cover the problems of transitional zones and sub-types or associations.

THE REGIONS

- (1) Highland Grassland and Highland Forest.
- (2) Scattered Tree Grassland: Low Tree-high Grass or *Combretum-Hyparrhenia*.
- (3) Coastal High Grass-bush.
- (4) Scattered Tree Grassland: *Acacia-Themeda*.
- (5) Semi-Desert Grassland, comprising Desert-grass Bush (Dry Bush with Trees) and Desert Scrub.

A map (G.P. No. 2347) showing these regions was printed by the Military Survey on behalf of the Department in 1945. The vegetation types are also briefly described and referred to a map in "Important Grassland Plants of Kenya", Edwards and Bogdan, which will shortly be published by Messrs. Pitman and Sons, London.

In the past, when the staff consisted of a single technical officer with African assistants, the facilities permitted of experimental work at one centre only, the Veterinary Research Laboratory Farm, Kabete. This station is situated at the lower transitional fringe of the Highland Grassland and Forest Region and it was the only place at which facilities were then available. Trials designed to elucidate management problems of natural grassland were, of necessity, attempted on a co-operative basis with farmers, and extension of the work on ley species conducted at Kabete was dependent upon trials at various agricultural centres with the co-operation of the field advisory staff.

Work at the Kabete Station

In the early stages of the work at this centre a study of the Kikuyu grass (*Pennisetum clandestinum*) dominated natural pasture was carried out and some of the results were published (see *Empire Journal of Experimental Agriculture*, Vol. VIII, pp. 101-110, April, 1940). In recent years the work has been confined mainly to the evaluation of plants for use in the establishment of temporary leys, with particular reference to the indigenous flora, and to the study of crops for fodder storage.

The work of evaluating possible ley species has been conducted in four main sections: (1) Nursery trials where new material is collected and initially established; (2) 1/40 acre field observational plots where general performance, palatability and seeding qualities are studied; (3) 1/10 acre seed-production plots, containing plants of proved seeding quality which are otherwise promising (the object of this phase of the work is to increase the material sufficiently for the purpose of further experiments); and (4) the study of persistence and seasonal yield of herbage and nutrients under a system of monthly clips based upon statistically arranged experiments. Plants which emerge from these investigational stages are subjected to grazing trials, but facilities in regard to both staff and the availability of suitable animals have limited the amount of work which has been possible in this connexion at Kabete. The final step is large-scale commercial production of seed and this is at present in progress in the case of the Nzoia Strain of Rhodes grass (*Chloris, gayana*), which is of proved value as a ley throughout the important agricultural region represented by the Scattered Tree Grassland: Low Tree-high Grass and parts of the transitional zone. Provision for the chemical studies implied under stage (4) above has not been available, and it has been necessary to store the samples to await the arrival of a chemist. Summaries of the results to date obtained in stages (1) and (2), the nursery trials and the 1/40 acre field observational plots, are given as an appendix to this report. (Not printed.)

Progress in the work at Kabete and the Scott Laboratories during 1950 concerned chiefly the establishment of further experiments and advance in others already established, as follows:

(a) MIXTURES OF SIX LEGUMES WITH CHLORIS GAYANA (NZOIA STRAIN), FOLLOWING PREVIOUS SIMILAR EXPERIMENTS

Object.—To determine persistence of the legumes under a system of monthly clips.

Locality.—Kabete.

Date of Commencement.—May, 1948.

Varieties.—In mixture with *Chloris gayana* under monthly clips—*Trifolium johnstoni*, Lucerne 37/S.4, *Crotalaria intermedia*, *Indigofera tettensis*, *Glycine javanica* and *Medicago denticulatum*. Weight of legumes adjusted on basis of per cent viable seed.

The appearance of natural *T. johnstoni* in all such experiments in this locality masks any effect of different legumes upon the soil and the information sought must therefore concern mainly persistence.

Design.—Randomized block, four replicates of each legume mixture as strips, 72 ft. by 5½ ft.

Results.—To date the only legumes which have persisted moderately well are Lucerne and *Glycine javanica*.

(b) GRASS MIXTURE EXPERIMENT

Object.—To compare the yields and persistence of pure sowings of Nzoia *Chloris gayana* and *Bothriochloa insculpta* with a mixture of these grasses and with this mixture when 37/S.4 Lucerne and *Glycine javanica* are included separately.

Locality.—Kabete.

Date of Commencement.—April, 1950.

Varieties.—*Chloris gayana* alone, 15 lb. per acre; *Bothriochloa insculpta* alone, 15 lb. per acre; *C. gayana* and *B. insculpta* each at $7\frac{1}{2}$ lb. per acre; plus Lucerne 1 lb.; plus *Glycine javanica* 1 lb.

The proportion of legumes is somewhat low because seed of *G. javanica* was in short supply. Again the presence of natural *T. johnstoni* in quantity will mask the results from the other legumes except in regard to persistence. Monthly clips on random quadrats are to be applied.

Design.—Latin square, 5 by 5. Each plot $56\frac{1}{2}$ ft. by 33 ft.

Results.—Not yet available. Experiment well established.

- (c) SEASONAL YIELDS OF HERBAGE AND NUTRIENTS FROM FOUR GRASSES WHICH HAVE REACHED AN ADVANCED STAGE IN THE WORK, COMPARED WITH TWO OF KNOWN PERFORMANCE. FOLLOWING PREVIOUS EXPERIMENTS OF THE TYPE
Object.—As above.

Locality.—Kabete.

Date of Commencement.—May, 1950.

Varieties.—Comparison of *Pennisetum stramineum*, *Cenchrus ciliaris* (erect form), *Setaria* sp. ex-Nandi, and *Melinis minutiflora* (Chania strain) with each other and with Nzoia *Chloris gayana* and *Bothriochloa insculpta*.

It is intended to apply a system of monthly cuts on random quadrats, but the plots are of sufficient size also to introduce the animal.

Design.—Latin square, 6 by 6. Each plot 30 ft. by 33 ft.

Results.—Not yet available. Experiment well established.

- (d) EXPERIMENT TO STUDY AN OBSERVED SELECTIVE EFFECT OF SUPPRESSION BETWEEN CERTAIN GRASSES.

Object.—As above.

Locality.—Kabete.

Date of Commencement.—December, 1949.

Treatments.—Plots of six species as follows, separated by 2 ft. wide paths:—

Hyparrhenia rufa.

Maize.

Pennisetum purpureum.

Digitaria scalarum.

Improved Kavirondo Sorghum, R.2S.42.

Bothriochloa insculpta.

Design.—Strip of plots, four replicates of each.

Results.—Not yet available. Suppression of maize by *P. purpureum* is just observable.

- (e) SEASONAL DIGESTIBILITY OF CERTAIN GRASSES (IN COLLABORATION WITH E.A.V.R.O. CHEMIST).

Object.—To determine the digestibility of grass species at weekly intervals by Lancaster's method, which depends upon the fact that the nitrogen excreted per unit organic matter ingested is constant.

Locality.—Kabete.

Date of Commencement.—March, 1950.

Varieties.—Nzoia *Chloris gayana*, *Bothriochloa insculpta* and *Brachiaria distyoneura*.

Design.—One-third acre plots, duplicated in a strip, two sheep to each plot. These plots were originally used for a grazing experiment with cattle.

Results.—Digestibility follows rainfall with a time-lag of about two weeks. Digestibility varies between 80 and 60 per cent, but there is little difference between the species.

Bothriochloa insculpta has given slightly the best result. Monthly chemical analysis has shown phosphorus to be low (order of 0.25–0.5 per cent), but the animals appear to remain healthy. *Chloris gayana* gave the highest P. figure (0.5 per cent) in the April flush period.

(f) EXPERIMENT TO TEST POSSIBLE TOXIC QUALITIES OF IMPROVED KAVIRONDO SORGHUM, R.2S.42.

Object.—As above.

Locality.—Kabete.

Date of Commencement.—March, 1950.

Treatments.—Weekly samples for chemical analysis, in (a) silage condition, and (b) aftermath. Grazing of aftermath by three cattle.

Design.—Block of land slightly more than one acre.

Results.—According to the literature 0.02 per cent HCN is regarded as the danger point. From chemical analysis the material at silage stage was found to be below this figure, but many of the aftermath figures exceeded 0.02 per cent. However, cattle grazed on the aftermath ate it readily and showed no ill-effect after several days, when analysis indicated 0.03 per cent HCN. The experiment continues.

(g) EXPERIMENT TO TEST UTILIZATION OF DOLICHOS SP. EX-KILIMA KIU. THIS IS A DEEP-ROOTED, PERENNIAL LEGUME OF CONSIDERABLE PROMISE. IT HAS BEEN INCREASED FROM A FEW SEEDS. IT IS APPARENTLY A NEW SPECIES WHICH HAS NOT RECEIVED A NAME.

Object.—As above.

Locality.—Kabete.

Date of Commencement.—April, 1949.

Treatments.—Palatability has been tested by means of feeding indoors and grazing five in-calf heifers on the plot. Hay has been made.

Design.—One acre block.

Results.—It was ensured that the animals were not hungry when the *Dolichos* was presented to them. Under these circumstances cattle require about two days to become accustomed to the crop. They afterwards consume it readily with no ill-effect. Five in-calf heifers fed on the plot for eight days.

(h) BREEDING AND SELECTION FROM KAVIRONDO PERENNIAL SORGHUM. ORIGINALLY OBTAINED FROM ONE PLANT FOUND NEAR MASENO, FOUR TYPES HAVE BEEN SEGREGATED BY OPEN SELECTION. THE IMPROVED KAVIRONDO SORGHUM, R.2S.42, AT PRESENT IN COMMERCIAL USE, WAS SELFED FROM ONE OF THE ABOVE TYPES.

Object.—Production of a rapid-developing silage crop for use under low rainfall conditions.

Locality.—Kabete.

Date of Commencement.—1941.

Varieties.—Four types rogued and resown each year. Separated by plots of *Crotalaria intermedia* and rotated with this crop.

Design.—

Results.—Improved Kavirondo Sorghum, R.2S.42, is in wide use, but the breeding area of the above four types is retained, since the material will probably be of value in future work.

(i) GRASS SEED DRESSING EXPERIMENT (IN COLLABORATION WITH A.E. AND C.I.)

Object.—To test the effect of various dressings in retarding the removal of seed by ants.

Locality.—Scott Laboratories.

Date of Commencement.—November, 1950.

Treatments.—Control, Agrosan G.N., Fernasan, YF.1443, Mergamma A. and YF.2438.

Design.—Randomized block, four replicates.

Results.—Only first quadrat count of seedlings so far made. The figures appear to show a decided advantage from most of the dressings, but analysis of the results may not be feasible, probably owing to uneven sowing. Seedlings have started to die out as the result of structurally deteriorated soil of the area.

(j) INVESTIGATION OF THE CAUSES OF POOR FIELD RESULTS FROM GRASS SEED

This work is aimed at (1) discovery of causes of poor quality seed; (2) determination of optimum depth of sowing in respect of various species; and (3) studying and confirming the effect of a dense cover of seedlings (e.g. Sorghum) in conserving moisture at the soil surface and so aiding early establishment.

The investigation was started in 1947, and laboratory work has shown that a high proportion of unripe seed, resulting from unsatisfactory harvesting methods and uneven ripening, is the chief cause of poor quality in the seed of two grasses already in commercial use, *Chloris gayana* and *Melinis minutiflora*. *Bromus marginatus* presents little difficulty.

Some results have been obtained in connexion with depth of planting on a small scale, but at least three attempts to establish field experiments dealing with this factor and the effect of the nurse crop have failed. The experiments were sown on a Latin square design, and failure of the species to become established was due primarily to the extreme state of structural deterioration of the soil in the area, although rainfall was also deficient.

(k) PASTURE PLANT NURSERY AT SCOTT LABORATORIES

Mr. Bogdan, Pasture Research Officer, has collected a large number of grass and legume species and established them in small plots. Preliminary observations are made with a view to selecting materials for inclusion in the work at Kabete.

(l) FURTHER TRIALS AND INCREASE PLOTS AT KABETE

(1) Preliminary trial of Nzoia *Chloris gayana* in mixture with *Indigofera retroflexa* (= *I. subulata*). The object of this plot is to obtain a preliminary indication with a very promising legume.

(2) Ley of Nzoia *Chloris gayana* to utilize $4\frac{1}{2}$ acres of land available for further experiments. The ley was sown in April, 1950, and in October, 1950, gave 155 cow-days grazing per acre.

(3) Reservoir of pure seed of Nzoia *Chloris gayana*, $\frac{2}{3}$ acre.

(4) Seed production plot (1 acre) of *Bothriochloa insculpta*.

(5) Seed production plot (2 acres) of the Alego Ecotype of *Chloris gayana*.

(6) Reservoir of pure seed of improved Kavirondo Sorghum, R.2S.42, $\frac{1}{4}$ acre isolated.

(7) An attempt was made to increase the seed of four promising grasses, *Cenchrus ciliaris* (erect form), *Pennisetum stramineum*, *Melinis minutiflora* (Chania strain) and *Setaria* sp. ex-Nandi in 1950 on five acres of land at the Scott Laboratories. Owing to deteriorated soil, the seedlings died off, only a portion of the *Setaria* plot surviving in the shade of trees.

(8) Seed production plots of *Crotalaria intermedia*, approximately $\frac{1}{2}$ acre.

(9) Seed production area of Nzoia *Chloris gayana* at Thika controlled from Kabete.

This is a major project covering 80-100 acres. It has been undertaken on the Sisal Research Station, with a view to providing a commercial seed supply for disposal through an agent. Sowing was carried out in April, 1950, and the area of grass is, in general, fairly well established.

In the above summary of work at Kabete during the year, attention might be drawn to several items in particular. These are: (a) The establishment of a statistical experiment containing the four grasses *Cenchrus ciliaris* (erect form), *Pennisetum stramineum*, *Setaria* sp. ex-Nandi and *Melinis minutiflora* (Chania strain) with the two grasses Nzoia *Chloris gayana* and *Bothriochloa insculpta*, of known performance and proved value, for comparison. The four promising grasses have reached an advanced stage in the work and this experiment, designed to record persistence and seasonal yields of herbage and nutrients, provides an instrument for further evaluation of the grasses. (b) The discovery that *Glycine javanica*, a local indigenous legume, is capable of withstanding a severe clipping treatment when in mixture with Rhodes grass (*Chloris gayana*). Hitherto, lucerne is the only legume which has proved successful in this connexion. (c) Preliminary trials with the perennial *Dolichos* sp. ex-Kilima Kiu. (d) The successful establishment of the large seed-production area of the Nzoia strain of *Chloris gayana* at Thika. This project was taken up following two production schemes based upon private growers which proved inadequate in previous years. There is good prospect that the Thika area will produce a full harvest in 1951, and disposal of the seed under careful control as to quality and purity has been arranged through an agent.

Reports of Pasture Research Officers

The attached reports of the Pasture Research Officers at the recently acquired regional research station, Kitale, and at the agricultural station, Ol Joro Orok, indicate the progress which was made towards the establishment of new investigational work. That of the Pasture Research Officer, Scott Agricultural Laboratories covers the main activities of this officer during the year.

Identification of Pasture Plants

Work on the grassland flora of Kenya was continued by the Pasture Research Officer at the Scott Agricultural Laboratories, and a list of grasses with keys for identification was prepared for publication.

The material identified for departmental officers and farmers consisted of 172 plant specimens.

Exchange of Plant Material With Countries Abroad

Planting material was supplied on request to the following countries:—

Uganda, Nyasaland, Palestine, Southern Rhodesia, South Africa; Israel, U.S.A., India, Australia, Thailand, Gold Coast, Malaya, Tanganyika, Zanzibar, Belgian Congo, St. Helena and Panama.

Material was received from Puerto Rico, Florida and Nyasaland.

D. C. EDWARDS,

Senior Pasture Research Officer.

ANNUAL REPORT OF THE REGIONAL GRASSLAND RESEARCH STATION, KITALE, 1950

(*Combretum-Hyparrhenia*)

Research and Investigation

In the period during which this station was used as a Soil Conservation farm, considerable work had been done by Mr. Maher on the establishment of grass leys and trial plots. This work, as well as all the development which has taken place on the farm, is of the greatest value and interest.

The experimental programme for the Grassland Research Station cannot yet be set out in detail, as many changes have been necessary and a number of important points are still under consideration. The work will fall into a number of divisions. Plans for investigation and work on the following are in hand:—

- (1) The collection of a herbarium and general study of the vegetation of the region as a whole.
- (2) Experiments on natural grassland. These will include a study of grazing management, burning, mowing, bush control, fertilizing, surface cultivation, etc.
- (3) Experiments on temporary leys. These will include the initial nursery work, small seed production plots and the evaluation of both grasses and legumes: also preliminary grazing trials, grazing management, the effect of fertilizing, the effect of the ley on soil fertility, etc.
- (4) Fodder conservation. Work to include studies in—
 - (a) conservation of fodder *in situ* by the growing of crops especially suited for grazing in the dry season;
 - (b) silage making with various grass and legume species;
 - (c) haymaking.
- (5) Fertilizer trials. Work will include co-operative experiments on farms which have already been started by the Highland Fertilizer Scheme. It is proposed that an experiment to measure yields from fertilizing through the live weight increase of beef steers, shall be put down.

N.B.—The foregoing is a brief survey of the long-term experimental programme. It is not of course visualized that work on all these aspects of grassland husbandry will be undertaken at once. Experiments will be carried out starting with those items which have the greatest immediate practical importance, and will be extended as and when facilities and staff become available.

R. STRANGE, *Agricultural Officer*
(*Pasture Research*).

ANNUAL REPORT OF THE PASTURE RESEARCH OFFICER, OL JORO OROK, 1950-51

(High Altitude)

The Pasture Research Officer commenced duty at Ol Joro Orok on 14th February, 1950.

The Latin square clipping experiment planted in 1948 to compare the productivity of five European grasses, *Bromus marginatus* and two indigenous grasses was continued throughout the year. Under the conditions of the experiment Nzoia Rhodes grass has given the best sward and highest yield during the third year closely followed by *Bromus marginatus*; the *Snodonia* sp. has deteriorated considerably during 1950.

Row Planting of Herbage Species.—As the main limiting factor to grassland improvement at Ol Joro Orok over a large period of the year is soil moisture, various trials have been planted during 1950 to observe the effect of row planting at different spacings on establishment and productivity. The results are distinctly promising and indicate that, it may be sound policy to concentrate on row planting technique and determine the optimum spacing to achieve maximum productivity of different herbage species and simple grass-legume mixture.

Grass Evaluation Trial.—A preliminary trial of 17 grasses was planted during the year to obtain figures for seasonal productivity, crude protein, fibre, lime and phosphorous content. A basal dressing of 100 lb. single super and 100 lb. sulphate of ammonia was applied in the row after establishment to all grasses.

Pilot Plot Grazing Trial.—Plots of 23 grasses have been established to observe the effect of the grazing animal and to obtain an estimate of herbage production throughout the year. A basal dressing of 100 lb. single super and 100 lb. sulphate of ammonia was applied in the row after establishment.

The year at Ol Joro Orok falls into two contrasting seasons: a short, cold wet and a long, hot dry season. Pasture work is concerned therefore, with the trial and selection of suitable species to fit into these two contrasting seasons. Introduced species such as Kentucky 31 fescue show promise for utilization during the wet season and indigenous species of the star grass, Rhodes grass and Guinea grass families demonstrate ability to withstand grazing during the dry season.

Seed Production Trial—Kentucky 31 Fescue.—Kentucky 31 fescue was row planted in a randomized block at three spacings, 2 ft., 2½ ft. and 3 ft. respectively. The amount of seed sown per acre at the 3 ft. spacings was 10 oz. For comparison an adjacent area was sown broadcast at 15 lb. per acre. A basal dressing of 100 lb. single super and 100 lb. sulphate of ammonia was applied to all plantings after establishment; row placement of fertilizer on one side of the row only with the row planted material being employed. The results from the first year show that row planting gives a much better establishment and subsequent growth than broadcast seeding. Seed production has been particularly good from all the row planted material. The plants in the 3 ft. rows are larger and more vigorous than the 2½ ft. or 2 ft. rows, which underlines the need for critical work on spacings to determine the optimum distance for various herbage species. The yield per acre of cleaned seed was 80 lb. approximately, purity varied from 81.5 to 94 per cent and the germination ranged from 80.1 to 89.8 per cent.

Nzoia Rhodes Grass Establishment Trial.—A small trial was laid down to examine the factors which affect the establishment of Nzoia Rhodes grass. The treatment included rolling, three different types of harrowing and the influence of different nurse crops. Results demonstrate that broadcast seeding is absolutely essential for establishment and that neither harrowing or rolling have any significant effect.

Trial of Kenya Grown Seed of Temperate Grasses and Legumes.—A small trial was established to contrast the growth and seed production of various temperate grasses and legumes from Kenya seed and imported seed. During the first season the growth and vigour of material grown from Kenya seed showed no improvement over imported seed. Cocksfoot showed ability to hold a proportion of green foliage in the dry season under row planted conditions. Subterranean clover flowered freely and set seed; Hunter River lucerne established well.

Rye Grass.—A disturbing feature in connexion with the cultivation of Italian rye grass and perennial rye grass under Kenya conditions is a tendency to reversion. This reversion produces a vigorous, stemmy, heavy seeding type of plant similar to darnel, *Lolium temulentum*, which may become a very serious weed. As cocksfoot is more drought resistant than rye grass and possesses the valuable property of frost resistance it is considered advisable to use this grass or perhaps Kentucky 31 fescue in preference to rye grass until more information is available on the reversion of rye grass.

Trial of Various Legumes.—The following legumes showed promise during the 1950 season. Serradella, *Ornithopus sativus* ex-Germany grew well under dry season conditions, flowered freely and a seed crop equivalent to 260 lb. per acre was harvested during January. A portion of the plot was cut for hay on 14th December and gave a mean green matter yield equivalent to 7.5 tons per acre. It is noteworthy that after taking a hay cut in the middle of the dry season, serradella gave a good aftermath which flowered freely and set seed. Perennial *Dolichos* ex-Kilima Kiu shows ability to grow and remain green during the dry season. Sweet clover is growing well in the dry season, particularly Madrid sweet clover and the possibility of undersowing it with wheat as a green manure will be investigated this year. Pigeon pea, *Cajanus indicus* ex-Queensland has developed well under dry season conditions, shows no damage from frost and is flowering freely. Smooth burr clover ex-Uruguay has flowered freely and set a heavy crop of seed.

Trial of Fodder Sorghums.—Three varieties of fodder sorghums from the Argentine are under trial to determine their productivity and nutritive value under season conditions.

Star Grass Soil Fertility Relationship.—In co-operation with the Senior Soil Chemist an investigation has been commenced to determine whether there is a soil fertility relationship which enables star grass to become dominant in regions infested with *Pennisetum schimperi*. The preliminary results indicate that adequacy of available phosphates favours star grass invasion and deficiency in exchangeable CaO and acid conditions both operate against such invasion.

Soil Profile Examination and Analysis.—The Senior Soil Chemist has undertaken the analysis of soil samples from various areas as a preliminary step to carrying out pasture improvement. It is hoped that a soil map may be prepared of the pastoral areas which will enable experimental work to be developed on the main soil types with precision.

Death of Whistling Thorn in Laikipia.—An area exceeding 500 acres of whistling thorn, *Acacia drepanolobium* Harms. ex-Sjostadt, in Laikipia was found to be completely dead. No burning had been carried out in this area for at least ten years. It was suspected that the cause of death might be due to borer attack as areas of Acacia in Queensland have been killed by borers. The Forest Entomologist, Mr. J. L. M. Gardner, has identified the insect chiefly concerned as *Xystrocera dispar* of the family *Cerambycidae* and he considers the attack to be typically secondary.

Naro Moru Sub-station, Staff.—Mr. Freeguard was in charge of the station until his ultimately death in October when Mr. A. Ballard, Assistant Agricultural Officer took over.

Grassland Experiments.—During the year a pilot plot programme of grassland experiments was drawn up but due to the failure of the short rains it was not possible to carry out planting.

Management of Natural Pasture—Themeda Triandra.—The objective of this experiment is to determine the effect of different degrees of rotational grazing with and without burning on natural grassland at Naro Moru. *Themeda triandra* is the dominant in the natural grassland but invasion by *Pennisetum schimperi* has occurred over small areas.

General.—During the year four talks were given on pasture research and a Farmers' Day was held at Ol Joro Orok in November which was very well attended.

Acknowledgments.—Thanks are due to Dr. H. G. Thornton, F.R.S., of the Rothamsted Experimental Station for his kindness in preparing a culture of serradella Rhizobium and forwarding some to Kenya for the inoculation of this promising legume. The ready co-operation of the Senior Plant Pathologist in making sub-cultures of various Rhizobia for legumes and the assistance of the Senior Entomologist in examining seed of *Brachiaria brizantha* for insect larva is gratefully acknowledged. The valued help of the Senior Chemist with soil analytical work on pastures is greatly appreciated.

J. L. SCHOFIELD,
Pasture Research Officer.

ANNUAL REPORT OF THE PASTURE RESEARCH OFFICER, SCOTT AGRICULTURAL LABORATORIES, 1950

In 1950 the work was carried out on the following main lines:—

- (1) Grass and legume nursery.
- (2) Soysambu grazing experiments (observations on composition of the grass cover).
- (3) List of Kenya grasses.
- (4) Identification of plants.

The Pasture Research Officer was absent on vacation leave from 10th March to 10th September, 1950.

Grass and Legume Nursery

Object.—In the nursery a number of indigenous grasses and legumes are cultivated in small plots with the object of selecting the species promising for introduction into cultivation and of studying the biological and ecological features of Kenya grasses and legumes in order to obtain better understanding of their behaviour in natural pastures.

Locality.—The Scott Agricultural Laboratories, Nairobi.

Date of Commencement.—February, 1948.

Treatment and design.—Small observational plots.

Summary of Results to Date. (a) *Grasses.*—Out of about 130 species cultivated in the nursery, the following were found to be promising (the species selected as promising in 1949 and mentioned in the 1949 annual report are not included here):—

- (1) *Eragrostis caespitosa*, Chiov.—Tufted perennial of dry areas forming low cushions with numerous soft leaves. Seed is produced well.
- (2) *Setaria sphacelata*, Stapf & Hubbard.—Two ecotypes of this species were found to be promising.

(b) *Legumes.*—Out of about 40 species cultivated in the nursery the following 6 species were found to be promising:—

- (1) *Alysicarpus glumaceus*, DC.—Bushy perennial herb with numerous stems. Seed is satisfactorily produced.
- (2) *Clitoria ternatea*, L.—Twining perennial herb with promising seeding qualities.
- (3) *Astragalus abyssinicus*, Hochst.—Tall erect perennial herb. Seed is plentifully produced.
- (4) *Dolichos falcatus*, Klein (= *D. debilis*, Hochst).—Twining perennial herb.
- (5) *Indigofera subulata*, Vahl (= *I. retroflexa*, Baill).—Perennial herb with numerous suberect stems. Seed is plentifully produced. This species has shown satisfactory results in larger plots.
- (6) *Vigna* (?) *oblongifolia*.—Annual twining herb.

Soysambu Grazing Experiments

These experiments were commenced in 1947 in co-operation with the Agricultural Officer, Nakuru and the management of the Soysambu Estate with the object of discovering practical methods of suppressing *Aristida keniensis*, an annual grass of inferior quality invading the pastures. Transect readings and general observations on the grass cover were continued in 1950.

Object.—To find methods of pasture management suitable for suppressing *Aristida* in Star grass (*Cynodon*) pastures.

Locality.—Soysambu Estate, Elmenteita.

Date of Commencement.—July, 1947.

Treatment and Design.—

- (a) Heavy seasonal grazing (cattle, 3 acres per head).
- (b) Heavy seasonal grazing (cattle, 3 acres per head) with subsequent harrowing.
- (c) Light seasonal grazing (cattle, 15 acres per head).
- (d) Permanent grazing, cattle.
- (e) Permanent grazing, sheep.
- (f) Mowing.
- (g) Burning.
- (h) Permanent rest.

Size of the plots.—From 2 to 20 acres.

Summary of results to date.—

- (a) Mowing, burning and resting resulted in quick and almost complete suppression of *Aristida*.
- (b) Heavy grazing in wet seasons resulted in only slight decrease of *Aristida*. The grass cover under such treatment rapidly deteriorates and perennial grasses fail to recover between the grazing periods.
- (c) Heavy grazing in dry seasons resulted in conspicuous decrease of *Aristida*. Perennial grasses recover well between the grazing periods, forming a fairly even cover.
- (d) Light season grazing resulted mostly in conspicuous decrease of *Aristida*. Plots under light grazing (15 acres per head of cattle, per year) show some signs of undergrazing (only the most palatable grasses are grazed and old growth is accumulating).
- (e) Permanent grazing of cattle resulted in slow but continuous decrease of *Aristida*.
- (f) Permanent grazing of sheep maintained a high proportion of *Aristida* during the first two years of the experiment. In 1950, however, the proportion of *Aristida* conspicuously decreased. Permanent grazing by sheep also resulted in creating an uneven grass cover with bare patches and patches of old, unpalatable growth.
- (g) General decrease of *Aristida* in the Estate was observed in 1948 and 1949.

List of Kenya Grasses

A list of Kenya grasses with keys for identification was completed and prepared for publication in December, 1950. The list, which includes 423 species, is a result of 4 years' work on Kenya grasses in the course of which, apart from extensive field observations, all the larger East African herbaria containing grass specimens from Kenya were studied. In 1950, during the Pasture Research Officer's visit to London, the names of most of the species included in the list were checked in the herbarium of the Royal Botanic Gardens, Kew.

Identification of Plants

One hundred and seventy-two plant specimens (mostly grasses, legumes and poisonous plants) were identified in 1950 for departmental officers and farmers.

A. V. BOGDAN,
Pasture Research Officer.

ANNUAL REPORT—HORTICULTURE, 1950

General Administrative and Extension Work

FRUIT CROP, 1950-51

Another dry year has again resulted in a variable fruit crop. Apples set a poor crop on the Kinangop. The pear crop in Molo was rather light following a very heavy crop last season. The biggest grower in Molo had much of his apple and pear crop badly damaged by hail. The early plums were very good, but late varieties suffered from drought. At the coast the citrus season was very short owing to drought.

SEED CROPS

Most of the acreage consisted of garden peas grown under contract to the United Africa Co. On the whole yields were rather disappointing. Crops have been supervised by United Africa Co. field staff seconded from Batchelors Peas Ltd. There is no doubt that growers have greatly benefited by this technical help.

An experimental area of lettuce was grown for the French firm of Clause; results were not good owing to the dry season.

IMPORTATION OF FRUIT TREES

Year	No. of Packages	Value in Sh.	Acres
1946	301	43,380	—
1947	344	58,451	—
1948	426	71,640	240
1949	556	88,523	228
1950	854	70,640	230

IMPORTATION OF FRESH FRUIT

Year	Country of Origin	No. of Packages	Value in Sh.	Kind of Fruit
1946.. ..	E.A. Territories	69,954	548,941	Mixed
	South Africa	20,054	687,974	„
1947.. ..	E.A. Territories	14,811	116,015	„
	South Africa	28,356	670,067	„
1948.. ..	E.A. Territories	20,218	139,484	„
	South Africa	28,913	541,645	„
1949.. ..	E.A. Territories	21,250	202,754	„
	South Africa	13,553	320,783	Apples
	South Africa	20,850	322,032	Mixed
1949.. ..	Australia	1,681	52,488	Apples
1950.. ..	E.A. Ports	23,270	219,806	Mixed
	South Africa	24,884	389,135	„
	South Africa	19,007	472,533	Apples
	Australia	431	17,319	„
	Italy	3,400	128,822	„
Total Value of Fruit Imports, 1950			Sh. 1,227,615	

The total value of fresh fruit imports again shows a very sharp increase over previous years. The increase over the 1949 figure is Sh. 329,558. When one considers that the wholesalers and retailers profits have to be added onto the above figures, and that there is in addition a considerable quantity of local fruit sold, one realises that fresh fruit is quite an important item in the consumers budget.

Research and Investigation

TREE FRUITS

Apple Rootstocks.—Poor results were obtained in grafting the trees required for the apple rootstock trial; the number of successful grafts will be insufficient for planting the trial. It is thought that conditions in the present nursery are unsuitable for grafting, particularly in a dry season. A new nursery site for grafting work is to be developed in a more favourable situation.

Growth of Gravenstein apples on the rootstocks E.M. XIII, E.M. Immune 10, E.M. Immune 12, and E.M. Immune 411, is now less rapid than growth of this variety on Seedling Crab rootstocks. There are signs that the Seedling Crab rootstock is too vigorous for Gravenstein; two-year old trees planted in 1946 carried only a few fruits in the 1950-51 season, and vegetative growth appears to be excessive. The age of the trees however, does not warrant a definite conclusion in this respect.

The rootstock layer beds in the nursery have been converted into stool beds and considerably extended.

There is a considerable difference in the ease of rooting of the various rootstocks. Ease of propagation is a most important point from the nurserymen's point of view. The number of rooted plants per stool lifted from the following stocks in May were as follows:—

No. of Stools	Rootstock	Average No. Rooted Plants per Stool
25	M. Immune 10	11.7
92	M. Crab 'C'	2.8
23	M. Immune 12	7.3
25	M. Immune 411	5.4
22	M. I (Broadleaf)	2.6

The inarching of vigorous rootstocks onto mature trees on Northern Spy rootstocks, which was tried in several private orchards, was not successful. It proved quite easy to establish the new rootstocks under mature trees, but no graft union resulted when the rootstocks were inarched into the trunk of the mature tree.

Top Working.—The top working of unsatisfactory varieties by the frame working method (*see* report for 1949) has proved very successful. There is no doubt that growers should make more use of this method of converting unsatisfactory varieties.

Details of trials on top working citrus trees will be found in the separate report for Matuga.

GENERAL OBSERVATIONS ON INDIVIDUAL TREE FRUITS

A full report on plum varieties has already been submitted for separate publication.

The outstanding apple variety at present is Blenheim Orange, which on Cape Seedling rootstock, not only makes vigorous growth, but is a most precocious cropper. Two-year old trees planted in 1947 averaged 14 lb. of fruit per tree

in the 1950-51 season. Grown in England, this variety is most difficult to get into bearing, but here it appears to be more precocious than any other variety which is under trial. Unfortunately Blenheim Orange is susceptible to Bitter Pit and Internal Breakdown of the fruit. These troubles will form the subject of future investigations.

Most apple and pear varieties planted at Molo are not yet in bearing.

Apricot varieties are starting to bear, but the fruit suffers so badly from physiological cracking, that planting of apricots cannot be recommended. The cause of this trouble is unknown at present but various theories are to be investigated. Artificial shading of the trees, which was tried at Molo this season, had no observable effect on the incidence of fruit cracking.

Peaches do not appear to be well adapted to the Molo climate. Growth of the trees is good, but the fruit does not colour well, and is of rather poor flavour and small size. It is thought that the poor fruit quality is due to the low summer temperatures at Molo.

Fruit Drying.—Keiffer pears were again dried successfully. Packed in 1 lb. cellophane packets and pressed flat they make an attractive product. Samples submitted to the trade and to consumers have been favourably reported on. This season one of the biggest growers of pears is to start drying on a commercial scale.

Trials have been made at Molo of sun drying plums of the Methley type. Ripe eating plums were first dipped for a few seconds in a hot solution of caustic soda; dipping causes the skin of the fruit to crack in a fine network, and is essential to allow moisture to escape from the drying fruit.

The plums were sun-dried on pyrethrum trays, the process takes about ten days. The resulting products was quite unlike dried prunes, being quite acid and very much smaller, but very palatable either in the raw state or cooked.

Prolonged Dormancy.—Most growers who have used oil sprays this season report favourable results. There is no doubt that all those who saw the results of oil spraying on trees at Molo were greatly impressed.

With plums, varieties which are classed as susceptible to prolonged dormancy react very strongly to oil spraying. Some examples of this are as follows:—

Plum, Beauty—	Lb.
Average crop per tree from sprayed trees	21
Crop from unsprayed tree	Nil

Plum Shiro—	
Average crop per tree from sprayed trees	37
Crop from unsprayed tree	3.5

Plum varieties which are classed as highly resistant to prolonged dormancy react favourably to oil spraying as young trees, that is, before they come into bearing. When such varieties come into bearing there are indications that the crop will be reduced by oil spraying. Examples of this are as follows:—

Plum, Tazagine—	Lb.
Average crop per tree from sprayed trees	47
Average crop per tree from unsprayed trees	77

Plum, Methley—	
Average crop per tree from sprayed trees	31
Average crop per tree from unsprayed trees	66

The only apple variety from which it has been possible to record the reaction of yield to oil spraying is Blenheim Orange. The result here was as follows:—

	<i>Lb.</i>
Average yield from sprayed trees	14
Yield from unsprayed tree	2

It must be emphasized when these results are considered that (a) they are for one season only, and (b) they apply only to trees grown in similar climates to the Molo Station.

With regard to (a) a trial was started in the 1950-51 season to assess the cumulative effects of oil spraying on both growth and yield. A tentative estimate of 5 years is given before results could be considered as in any way final, and a longer period would be desirable.

With regard to (b) although it may not be advisable to spray a mature Methley plum tree grown at this Station because oil spraying may reduce the crop, quite the opposite result may be expected if a Methley plum tree grown at say Njoro or Lessos is oil sprayed. Again a certain reduction of crop may be an advantage with a variety like Methley which has a tendency to overbear.

It is obvious from the above results that much work remains to be done on artificial breaking of the dormancy period. Specific recommendations on whether a variety should, or should not, be sprayed in any particular climate, must depend on whether that variety is showing symptoms of prolonged dormancy.

Nutrition.—This season a very much larger number of trees was sprayed with magnesium sulphate to counteract magnesium deficiency. Trees were sprayed with a 2 per cent solution of magnesium sulphate. Sprays were applied at fortnightly intervals, starting on 8th December, 1950. From 4 to 6 applications were made.

Observations of the reaction of each sprayed tree compared with control trees of the same variety give rather mixed results. It would appear that sprayed trees generally show less leaf symptoms than unsprayed trees.

Spraying this year was started about 4 weeks later than last year. It is quite possible that later spraying has resulted in a less marked reaction than was observed on sprayed trees last year.

Trees which received a soil dressing of magnesium sulphate in 1949 do not show any decrease in symptoms over control trees; it is doubtful whether soil dressing is worth while.

Trees which received foliage sprays in 1949, but not in 1950 show little or no reduction of foliage symptoms in 1950.

Next season it should be possible to combine tissue tests for magnesium, with observation of the leaf symptoms; this method should make possible a cleaner assessment of the trees reaction to different treatments.

BERRY FRUITS

Strawberries

Royal Sovereign, M.40, which was very promising at Molo has proved a failure. The variety is very susceptible to Strawberry Leaf Spot. No crop worth mentioning was harvested after the first few months. This result has been confirmed by trials on private estates.

The *Melba* strawberry when grown at Molo under overhead irrigation yields for many months; it is not yet known for how long.

Oberschlesien, which is a popular canning variety in England, has proved a failure. It is susceptible to Strawberry Leaf Spot. The fruit is soft and inclined to rot on the plants.

Huxley, M. 44, is so far the most promising of the varieties imported from England. The plants are vigorous, and only slightly infected with Strawberry Leaf Spot. They crop for a long period under irrigation. The fruit is firm and of regular shape, but the flavour is not outstanding. It is, however, thought to be better than that of *Melba*.

This variety is recommended for limited trial by growers, but it is not possible at present to recommend it for general planting. Plants have to be imported from England by air as no local stocks are available for distribution at present.

The following varieties were imported from England recently; a report on their behaviour will be issued later.

Early Cambridge.

Jardine de Leopold.

Madame Lefebvre.

Cambridge Seedling No. 448.

Cambridge Seedling No. 449.

The following varieties have been ordered, but not yet received:—

Auchincruive Climax.

Sir Joseph Paxton.

Royal Sovereign M. 40 X Melba.—These two varieties have been crossed at Molo but so far the seed has not germinated. It is possible that the seed is not viable. The cross is to be repeated.

American Seedling strawberries were grown from seed obtained from Carolina through the C.A.B. The seed was obtained from crosses of the varieties Eleanor Roosevelt X Massey and E. Roosevelt X NC 1053. Individual seedlings show a great variation in vigour and flavour of fruit. The most promising individuals are being propagated vegetatively as clones. It is thought that some of the seedlings show considerable promise, both as regards flavour and size of fruit, and freedom from disease. Multiplication of a clone starting from a single plant is of course very slow, particularly when very few runners are produced.

Strawberries in Kenya do not behave in the same way as they do in Europe. Provided the plants are grown under irrigation, it is possible to produce fruits for most of the year. The total crop produced during this long cropping season is probably no greater than that borne by strawberries in England during their cropping season of a few weeks.

At Molo, strawberry plants seldom produce runners; this is probably due to low temperatures. The plants are propagated by division.

Raspberries

Seedling Raspberries grown from seed obtained from the John Innes Horticultural Institute in 1948 have not proved a success, and this trial will now be abandoned.

The seed was from the varieties Lloyd George, and Lloyd George X Norfolk Giant. Growth of the canes was fairly good, but after the growth period the canes go dormant and die back, instead of producing the lateral shoots on which the fruit is borne.

Malling Promise canes have been obtained from three sources; Mr. T. Hales of Lessos, the Waterperry School, Oxford, and the Scottish Raspberry Investigation, Dundee.

The three stocks are being grown separately. No report on this variety is available yet.

Norfolk Giant canes of the virus free New Zealand clone were obtained from the Waterperry School.

No report on this variety is available yet.

Youngberry fruited very successfully at Molo this season. The fruit is of excellent quality; it is suitable for eating fresh, for jam making, and for canning.

Loganberry fruited successfully at Molo this season. The fruit is not of such good flavour as the *Youngberry*, and its climatic range is considerably more restricted.

Youngberry X Wild Rubus sp.—This cross was made at Molo with the object of combining the extreme vigour of the indigenous *Rubus* sp. with the fruit qualities of the *Youngberry*. Seedlings of the cross have not yet been raised.

VEGETABLES

French Beans: Tendergreen.—An observational trial was planted at Molo with seed produced at Jacaranda Research Station from imported seed.

Size of plot, one-fifteenth acre.

Sowing date, 31st August, 1950.

Harvesting period, 23rd November, 1950, to 22nd December, 1950.

The last of the crop was left for seed.

Yield of green beans, 3,040 lb. per acre.

Samples sent for canning tests were reported on favourably.

The crop was remarkably free from disease.

Carrots.—Small observational plots of the varieties tabulated below were planted at Molo with Danish seed.

Sowing date, 17th April, 1950.

Plot size 60 to 80 sq. ft.

Harvesting period 8th September, 1950 to 16th October, 1950.

	lb. per acre
	Yield
Verton	106,939
Chantenay	135,616
Oxheart	126,985
Nantes	75,776
Regulus	143,616

The above yields are exceptionally high, but the small size of the plots must be taken into account.

Of the varieties tried, Verton produced roots of the best quality, with Nantes second. Poorest quality roots were produced by Regulus.

Beans of the following dwarf varieties were planted as an observational trial at Molo with Danish seed:—

Sowing date, 28th April, 1950.

Marche de Geneve, Snapbean.

Hundred for One, I, Snapbean.

Hundred for One, II, Snapbean.

Conserva, Snapbean.

Express, Wax bean.

Mogal, Wax bean.

Albaster, Sword bean.

The trial had to be abandoned as all varieties became severely diseased in the cold wet weather.

There is no doubt that the trial was sown too early in the season. In Molo beans should be sown only in August.

Garden Peas of the following varieties were planted as an observational trial at Molo.

Sowing date, 19th April, 1951.

The size of plot varied to the amount of seed available, average size 135 sq. ft.

	Period of Harvest	Yield per acre green peas in pod
Onward	3-8-50—15-9-50	4,854
Little Marvel	23-6-50— 8-9-50	4,840
Kelvedon Wonder	23-6-50— 8-9-50	3,219
Laxton's Progress	23-6-50— 3-8-50	2,117
Alderman	3-8-50—15-9-50	5,445
Lincoln	failed to germinate	
Gradus	23-6-50— 8-9-50	1,423
Olympia	24-8-50— 8-9-50	2,147
Appolo	19-7-50—15-9-50	7,298
Rika	3-8-50—15-9-50	4,948
Balder	did not flower	
Norrland (edible podded)	19-7-50—15-9-50	7,300

Canning samples of some of the varieties were sent to Kenya Cannery Ltd., for testing; they placed the varieties in the following order of merit:—

1. Laxton's Progress.—Laxton's Progress was an outstandingly good colour and good flavour but slightly inclined to break up.

2. Kelvedon Wonder.—Colour not as good as No. 1, otherwise good in all respects.

3. Little Marvel.—Quite good colour, shade almost identical with No. 6.

4. Thomas Laxton.—Colouring nearly the same as No. 3, but slightly larger.

5. Alderman.

6. Gradus.—A fair sample slightly off flavour (musty).

Canned samples were tested by four individuals at Molo and were placed unanimously in the following order for flavour:—

1. Kelvedon Wonder.

2. Little Marvel.

3. Laxton's Progress.

Onion.—Seed of Indian varieties, Gujrat and Kathiawar was received for trial from Messrs. Dalgety & Co., Ltd. Small observational trials were carried out at Molo, Kitale, Matuga and Jacaranda.

These varieties did not do well at Jacaranda and Kitale, whilst at Matuga the crop was stolen before maturity.

Results at Molo were as follows:—

Sowing date, 19th May, 1950.

Size of plots, Gujrat, 1,513 sq. ft. Kathiawar, 448 sq. ft.

The crop was harvested on 3rd January, 1951, and yields of dry bulbs were as follows:—

	Per acre
Gujrat	4,683
Kathiawar	4,850

The main object of the trial was to find out how long the dry bulbs would keep in store. The crop has now been in store for nearly three months; a few bulbs have produced shoots and there has been some shrinkage, but no rotting has been observed.

Small plots of the varieties Brunswick and Zittaner Yellow, sown from Danish seed, failed to bulb. These varieties evidently require a long day in order to produce satisfactory bulbs and are unsuited to our conditions.

Seed Crops

REPORT ON PEA SEED TRIALS AT MOLO, 1950.

Trials of five pea varieties for seed were carried out at the Department of Agriculture, Horticultural Station, Molo, in co-operation with The United Africa Co., (Kenya) Ltd.

The varieties under trial were as follows:—

Perfection Freezer.

Shasta.

Harrison's Glory.

Unica.

Mansholt's Pluk.

The trials consisted of a large field plot of each variety, and a small statistical trial of the last three varieties listed above.

The soil on which the trials were planted is a light volcanic loam of considerable depth, and of medium to high fertility. The previous cropping history of the land is as follows: 3 years under pyrethrum followed by 2 years under cereals. Double superphosphate at the rate of 100 lb. per acre was broadcast over the area and raked in immediately before sowing.

The seed was sown with a "Planet Junior" planter. This machine is not ideal for sowing peas as the spacing in the row tends to be uneven. Generally the seeding rate was too low owing to the uneven feed of the planter. Owing to wet weather at sowing time and to the fact that only one single row drill was available, seed sowing went on over a considerable period.

All varieties were planted in rows at a spacing of 14 in.

Seed of all varieties was dressed with "Agrosan GN" at the rate of 1½ oz. to 40 lb. of seed, before sowing.

TABLE 1

Variety	Sowing Dates	Acres Area Sown	Seeding Rate P/A	Germination
			<i>lb.</i>	
Perfection Freezer ..	22-7-50—26-7-50	0.792	50	fair
Shasta	26-7-50—29-7-50	0.798	50	poor
Harrison's Glory ..	31-7-50— 2-8-50	0.473	86	good
Unica	3-8-50— 4-8-50	0.667	69	good
Mansholt's Pluk ..	4-8-50—10-8-50	0.703	64	good

The plots were hand weeded on two occasions, from 24th August, 1950, to 9th September, 1950, and from 28th October, 1950 to 1st November, 1950. On the second occasion only the varieties Perfection Freezer and Shasta were weeded. The three other varieties had formed a sufficiently thick cover to smother most of the weeds.

Towards the end of September it was noticed that the peas were becoming infected with aphid. The infestation was considered bad enough to require treatment. Spraying was carried out on all varieties except one small area of Mansholt's Pluk, from 28th September, 1950, to 4th October, 1950. Spraying was carried out with a knapsack machine using Wetttable Agroside at the rate of 4 lb. to 100 gallons water. A few days after spraying all the aphid had disappeared, including those on the unsprayed area.

Mildew was observed to be developing on all varieties towards the end of October; at this period the sky was much overcast.

Harvesting was started on 1st December and completed shortly before the end of the year. Ripening was very uneven; on all varieties the bottom pods had started to shatter some time before the top pods were ripe. Certain areas of the plots ripened earlier than others through variations in the soil.

The varieties Perfection Freezer and Shasta were harvested partly by hand picking the pods as they ripened, and partly by pulling whole plants and placing in windows to dry.

The other three varieties were harvested entirely by pulling and windrowing the whole plants.

TABLE 2

Variety	Acres Area of plot	Yield clean seed	Yield P/A clean seed	Germination test per cent
		<i>lb.</i>		
Perfection Freezer ..	0.722	410	518	99.0
Shasta	0.798	492	619	98.5
Harrison's Glory ..	0.473	802	1,696	99.0
Unica	0.667	1,367	2,049	99.5
Mansholt's Pluk ..	0.705	992	1,411	99.5

The seed was threshed by hand after which it was put through a winnower. All the seed was hand picked after winnowing; the proportion of diseased or defective seeds picked out was extremely small for all varieties.

The statistical trial, which consisted of a randomized block with four replications of each of the three varieties, did not reveal a significant difference in yield.

TABLE 3

Amount and Distribution of Rainfall During the Trial

	Total inches	No. of days
July from 22nd only ..	2.21	8
August whole month ..	3.74	15
September	5.21	20
October	1.99	12
November	0.93	6
December	1.06	5

CONCLUSIONS

Yields of the varieties Shasta and Perfection Freezer can be regarded as satisfactory when the low seeding rate and indifferent germination are taken into consideration. Yields of the other three varieties are satisfactory. If a suitable market exists for marrow-fats and blue varieties such crops would be of value in a rotation with cereals, provided they can be harvested mechanically.

I should like to record my thanks to Mr. W. Tegergine and F. Curtis, of Batchelor's Peas, Ltd., for much help, both in a practical and advisory capacity, in the carrying out of these trials.

Miscellaneous Crops

Mangel's Sugar Beet, Swedes.—A trial to test varieties of these crops was sown at Molo on 1st May, 1950. The trial was observational, and the average size of plot was 21 ft. × 12 ft. All varieties were harvested on 12th December, 1950. Yield figures are given in the following table:—

Kind	Variety	Yield. per acre	% Sugar by Refractometer Test	Remarks
		<i>lb.</i>		
Mangel ..	Giant half sugar green top.	107,889 =48.2t	10	Easy to lift. Seed received from France
„ ..	Giant half sugar red top.	111,866	6	Difficult to lift. Seed received from France
„ ..	Giant yellow inter- mediate Vauriac.	111,890	8	Easy to lift. Seed received from France
„ ..	Yellow intermedi- ate Puisseux.	104,259	10	Easy to lift. Seed received from France
„ ..	Giant half sugar rose top.	55,328	9	Difficult to lift. Seed received from France
„ ..	Red cylindrical Eckendorf.	73,008	7	Easy to pull. Seed received from France
„ ..	Yellow cylindrical Eckendorf.	72,115	9	Easy to pull. Seed received from France
„ ..	Yellow intermedi- ate Barres.	62,278	8	Easy to pull. Seed received from France
„ ..	Mammoth long red	51,351	12	Difficult to pull. Seed received from France
Sugar Beet	Frisko	35,366	19	Difficult to pull. Seed received from Holland.
Swede ..	Balder	27,434	—	Seed received from Denmark.
„ ..	Ostgota II ..	42,914	—	Seed received from Denmark.
„ ..	Bangholm ..	53,750	—	Seed received from Denmark.
„ ..	Queen	27,520	—	Seed received from Denmark.

The trial was sown on 1-5-50 and harvested on 12-12-50.

About 10 per cent of the mangels were showing signs of heart rot when harvested, it is thought that this may be due to a soil deficiency of boron.

Hops.—Considerable interest is shown in Kenya in the possibility of growing hops commercially. Various attempts have been made to grow hops in the past, but without success. In 1949 a consignment of unrooted sets of five hop varieties was imported from Tasmania. We were advised by the Department of Hop Research, Wye College, to import from Tasmania, on account of the risk of importing hop diseases with hops from England.

The Tasmania sets were planted in a propagator at Jacaranda Research Station. The number of sets which rooted successfully and survived was only seven, three White Vine and four Lates. These were transferred to Molo in April, 1950.

Growth of the hops at Molo was most disappointing; in 8 months shoots only 1 in. long were produced and several plants died. It was thought that the lack of growth might be due to our short day and one plant was subjected to artificial light for 3 hours a night for several weeks; no improvement in growth was observed over unilluminated plants.

In November a further consignment of unrooted hop sets arrived by airmail from Tasmania, the journey had taken over one month and every set was dead on arrival at Molo.

An attempt is now being made to import planting material from South Africa, if the disease position there proves to be satisfactory.

In view of the results obtained to date it does not seem likely that hop cultivation will be possible in Kenya.

Mexican Hawthorn (*Crataegus pubescens*), is a fodder tree which has aroused considerable interest in South Africa. The economic uses of the fruit are as follows:—

Fodder for cattle.

Source of pectin.

Human consumption canned or made into preserves.

Articles on Mexican Hawthorn have been published in "Farming in South Africa", for January, 1949; June, 1950; and November, 1950. An extract from the article for June, 1950, reads as follows:—

"With our present knowledge, it would seem that the Mexican Hawthorn will be limited under natural conditions to regions where conditions are favourable for trees, i.e. with a good rainfall, and deep cool but well drained soil."

Nothing is known about the climatic range of the trees in Kenya, but it is thought that success will be unlikely below an altitude of 5,000 ft. Young trees have made rapid growth in the nursery at Molo.

Trials will be carried out by the horticultural section at Molo, Kitale and Jacaranda, and in co-operation with the Pasture Research Officer, at Ol Joro Orok.

A small number of trees is available for issue to other stations for trial in 1952.

Bees are necessary to ensure the adequate cross pollination of fruit trees, for this season two hives have been installed in block A. The hives are now inhabited by two strong swarms.

Insect Pests

Fruit Piercing Moth has again been troublesome this season. There was little damage on plums, but the peaches were heavily attacked. The bait traps used last season were quite ineffective. This season traps are again being tried with different baits. The main difficulty is to devise a bait which is more attractive to the moths than the fruit on the trees.

Scale on Pineapples, which has infested a considerable acreage of plants at Thika, has now disappeared.

Fruit Tree Borer has been found in isolated cases on trees in block A. At present this is a very minor pest at Molo, though troublesome in some districts.

Diseases

Armillaria Root Rot continues to kill odd trees in block A. When a tree dies a trench, 3 ft. deep, is dug round the dead tree, and mid-way between it and the adjoining healthy trees. The trench is left open for some weeks, it cuts all roots which are crossing into the infected zone.

A plan of block A is being kept, showing all trees killed by root rot, and from other causes, together with the date of death.

Infectious Plum Chlorosis, this virus disease is widespread in plum orchards, having been imported with trees from South Africa. Four October Purple plum trees planted in block A in 1946, started to show virus symptoms in December, 1950. This indicates that trees can be infected for long periods before leaf symptoms become visible.

Apple Mosaic, this virus disease is also widespread, there are many infected trees in block A. The virus does not appear to have a very harmful effect on the trees.

METEOROLOGICAL FIGURES FOR 1950

				Mean Temperature	Rainfall
				°F.	in.
January	..	..	..	57.1	0.32
February	..	..	..	57.2	0.25
March	..	..	..	57.9	2.66
April	..	..	..	57.8	7.91
May	..	..	..	56.0	3.38
June	..	..	..	56.3	4.13
July	..	..	..	53.8	8.18
August	..	..	..	55.1	3.74
September	..	..	..	55.3	5.21
October	..	..	..	56.4	1.99
November	..	..	..	56.3	0.93
December	..	..	..	56.7	1.06

Research and Investigation

MATUGA

A little work has been started at Tiwi and Malindi on "top-working" some of the old existing citrus trees. The object of the trial is to improve the trees which up to the present are producing unedible fruit such as the bitter seville and oranges, in the bitter sweet class. In all old Arab holdings these trees are to be found which produce their annual crop of fruit and this allowed to ripen and fall off without being harvested, as it is unmarketable owing to the bitter taste.

The technique employed is as follows:—

The tree is cut right back to the main branches, three or four limbs being left, properly spaced around the trunk to form the skeleton of the new tree.

New shoots or suckers will then start growing freely. These are thinned out and only the terminal shoots allowed to develop. When they have attained budding size, a scion of an improved variety of orange is then budded and from then on the care of the young budding follows normal nursery procedure.

Tomatoes.—Two trials were started during the year on different varieties of tomatoes for canning purposes. The first trial was terminated before any results were obtained owing to a virus disease "Cucumber Mosaic" wiping out the whole experiment. The second trial was brought to a conclusion but was also disappointing owing to insect pests which damaged approximately 50 per cent of the crop.

Tobacco Flue-Cured Type.—A small area of Virginia tobacco "Bonanza" was planted under irrigation to test the yields under coast conditions. The growth of the plants was exceptional and approximately 1,000 lb. of leaf was produced per acre. It was, however, found that for proper curing a barn equipped for the accurate control of heat and ventilation will be needed owing to the atmospheric moisture at the coast being too high.

Cape Gooseberries.—Two blocks 30 ft. × 30 ft. each have been planted to the above crop under irrigation. To date the growth has been excellent. No results of the trial can be given as the cropping period is only starting.

Coffee.—A trial of six varieties of coffee has been started, the object being to plant out a small area and record the yields under coastal conditions.

Seed of the following varieties was sown :—

- C. Arabica (Section K 7).
- C. Liberica.
- C. Excelsa (Ruiru).
- C. Robusta (Spreading).
- C. Robusta (Erect).
- C. Stenophylla No. 1 Ex. (Sierra Leone).
- C. Stenophylla No. 2 Ex. (Sierra Leone).

JACARANDA

Pineapple Propagation Experiment.—In June an experiment on the propagation of pineapple from cuttings was started. Various methods of propagation were tried, both under frames and in the open ground. Later, a further experiment to test the effect of treatment with hormones was started. The results are tabulated below.

FRAME CUTTINGS

Type of Cutting	Number set	Date of Insertion	Per cent Rooted	Per cent Dead	Transplanted in open ground	Remarks
ROOT DISC—						
1 ft. below surface ..	10	15-6-50	Nil	100	—	
Surface level ..	10	15-6-50	10	90	28-12-50	
LEAF CUTTINGS—						
(from fruit top)—						
Base leaves ..	12	26-6-50	Nil	100	—	
Medium length leaves ..	12	26-6-50	Nil	100		
Centre crown leaves ..	12	26-6-50	15.1	84.9	28-12-50	Had only just rooted.
TOP SEGMENTS ..	15	22-6-50	93.3	6.7	28-12-50	
	14	14-8-50	92.9	7.1	28-12-50	Number set represent segments from one top in each case.
	*14	14-8-50	100.0	Nil	28-12-50	Growth less vigorous than former.

*Treated with B-indolyl-butyric acid in 100 c.c. water and alcohol. Attempts to propagate the segments of fruit rind and disc portion of the tissue after the crown leaves had been removed were unsuccessful.

GROWTHS PRODUCED AFTER 99 DAYS

Hormones	Segments Surviving	Segments producing buds	REMARKS
	%	%	
B-indolyl-butyric acid	100	97	Control cuttings still more vigorous than treated cuttings.
Hortomone A	97.38	90.9	
Seradix B	100	97.1	
Control	97.38	97.5	

The object of this trial is to speed up the multiplication of pineapple planting material which is in very short supply.

So far no definite results have been obtained, but the following tentative conclusions may be drawn.

Large cuttings do not obtain any benefit from frame treatment. Watering is of benefit, however, both in the open and under frames. Where cuttings are small, insertions under frames will give a very much higher percentage rooting, but the vigour of shoot is dependent on the size of the cutting planted. Satisfactory results were obtained from fruit top sections cut into 8-16 portions.

Smaller cuttings make very slow progress. Cutting propagation in the open, during the rains, with no artificial watering has not yet yielded any results.

Tomatoes.—A trial of 11 tomato varieties started in February had later to be abandoned. Sufficient fruit was harvested, however, to give canning samples of eight varieties. A further trial, of 13 varieties was laid out in October.

Two Indian varieties of onion, Gujrat and Kathiawar did not do well, producing small bulbs, with thick necks.

Eight varieties of banana from Makuroni, and nine from Matuga have been planted for observation.

Some root cuttings of hops, from Tasmania did not do at all well, only seven surviving.

The two varieties of bean, Tendergreen and Blue Lake were sown, Tendergreen proving highly satisfactory. Blue Lake was badly affected by rust.

Seed of cashew nut, sown in September, germinated in 18 days, making rapid growth subsequently. Transplanting proved very difficult, many deaths resulting. In view of its free germination, and rapid progress it would appear most satisfactory to sow the seed in situ.

A small sowing of Mountain Pawpaw has been made, for subsequent planting to determine growth and yield under local conditions.

Publication.—A short monograph on the cultivation of Mountain Pawpaw was written for distribution to growers. This fruit is now required for canning.

T. H. JACKSON,
Agricultural Officer (Hort.).

ANNUAL REPORT FOR 1950 OF THE SENIOR AGRICULTURAL OFFICER (PYRETHRUM)

Experimental Stations

Ol Joro Orok (altitude 7,800 ft.).—The rains broke in March but little fell that month. Rainfall was good in April, however, and this brought on the flowering of the old crop well. Picking commenced in June and excellent picking conditions were obtained until near the end of the year. Rainfall was below average in November and December and this caused the crop to dry off rather prematurely. The total rainfall for the year was 33.80 in., 2.00 in. below the average. Yields from old crop were up to average but the crop planted this year suffered particularly from the dry weather at the end of the year and yielded disappointingly.

Planting took place in April and May, but owing to dry spells soon after planting, losses of stand were rather severe.

The building of a house for a European Assistant was started in November and fair progress had been made by the end of the year.

Molo (altitude 8,300 ft.).—The rains broke on 21st March, thus relieving the water supply position on the station which had become acute during the dry season. Growing conditions were very good during the early part of the season and excellent yields were expected. Conditions were abnormally dry towards the end of the year however, but in spite of this, yields were up to average. The total rainfall for the year was 39.76 in., the lowest rainfall recorded since the station was started in 1944.

It is at last possible to report that the water supply at this station is likely to prove adequate for all normal requirements. The dam was completed this year and is holding water satisfactorily and a borehole with a capacity of 2,500 gallons per hour has been completed.

A block of new land was added to the station and work carried out on making a new road to serve this area.

Towards the end of the year, work was started on the building of a house for an Assistant Agricultural Officer but this was not completed by the end of the year.

Subukia (altitude 7,000 ft.).—The work of testing out low altitude strains at this station was continued and satisfactory progress was made.

Rongai (altitude 6,500 ft.).—Through the kindness of Mr. P. G. Thorne, a small plot was started on his farm at Rongai. This is for testing some selections and crosses at an even lower altitude than that of the Subukia plots. This station is more accessible than the previous low altitude station at Kitale (6,300 ft.) which was closed in 1949.

Marindas (altitude 9,000 ft.).—A portion of the departmental plot at Marindas was used for testing plant breeding material at a very high altitude. This season, 200 selections and several crosses were planted there in addition to a fertilizer trial.

Plant Breeding

188 × 214.—In the 1949 Annual Report, it was stated that two crosses, 188 × 194 and 188 × 214, had given outstanding performances particularly at the low altitude station in Subukia. Early this year it was decided to proceed with the bulk seed production of 188 × 214 for issue. This cross was chosen in preference to 188 × 194 owing to its superior pyrethrins content, the yields and other characteristics of the two strains being very similar.

Vegetative propagation of the parent clones, 188 and 214, continued throughout the first half of the year and a total of 31,000 small plants were available by July. Ten per cent of these were held in reserve for further vegetative bulking and the remainder were planted out into four irrigable seed production plots

totalling 2.6 acres. Of this total, 1.6 acres were planted on the Molo and Ol Joro Orok stations and one acre was grown by two farmers, at Kaptagat and Subukia. The young plants made good growth and were beginning to bear seed by the end of the year. It is intended to make the first seed issue towards the end of 1951.

1970 Control.—This strain was originally derived from a small quantity of commercial seed which gave the extraordinary yield of 1,970 lb. per acre at Molo in 1948-49, easily a record yield. This year some of the plants have been grown as single plant selections and records kept of their performance, the remainder were grown in an isolated plot for seed production. Twenty-four pounds of seed were distributed to growers towards the end of the year for trial.

It should be noted that seedlings of this generation have never been tested and it is not known whether they will reproduce the exceptionally vigorous flowering qualities of the parent plants.

Seed Issues in 1950.—The present favourable price has led to a revival of interest in pyrethrum and there has been a considerable demand for seed of improved strains. With the exception of the 1970 Control seed described above it has not been possible to supply this demand from the experiment stations and it has been necessary for growers to obtain their requirements elsewhere.

Mr. O. E. Hopley, at an altitude of about 7,000 ft. in the Subukia Valley, has spent many years in producing his own strain of pyrethrum. It was not possible for him to select for high content but work was carried out on the production of a high yielding, low altitude strain. This strain has given very good yields and tests showed that the pyrethrins content was about average. Mr. Hopley kindly agreed to close part of his acreage for seed production and growers were informed that they could purchase this seed. Five hundred and ninety-two pounds of seed were sold to growers during the year.

Demand for seed of the original High Toxic strain has continued. The Pyrethrum Board made purchases from selected growers and retailed 1,921 lb. to growers during the year.

Powell Crosses.—An increase in the yield of pyrethrins per acre can be achieved either by augmenting the yield of flowers per acre or by improving their pyrethrins content or by a combination of both methods. It has been found difficult, in making selections from ordinary crop, to find plants which combined vigorous flowering with high content. Selections which flower prolifically are often low in content; high content plants are frequently weak flowerers. This tendency was demonstrated by two correlation studies of the yields and pyrethrin contents of selections from unimproved crop. In both cases, there was a statistically significant negative correlation between yield of flowers and pyrethrins content.

Some years ago it was decided to try to overcome this difficulty by crossing a low content, vigorous strain with various high content clones. The low content parent was a strain bred by Mr. G. S. Powell and this has been used in 13 crosses with high content clones. The result of the crossing was to produce plants with a moderately good content combined with increased vigour and large flowers. The increased flowering vigour more than compensated for the loss in pyrethrins content so that the yield of pyrethrins per acre was about 50 per cent greater than from crosses derived from two high content parents in a trial at Ol Joro Orok. The Powell crosses were not quite so successful, however, at Molo and it is considered that they would prove most valuable at medium altitudes. It is proposed to produce seed of some of these crosses for issue, probably as a mixture.

It is probable that these crosses contain individuals which combine the good qualities of both parents to an exceptional degree. Bulk plots of the various crosses were therefore established and many selections were made from these plots in 1950.

High Altitude Strains.—The varieties described in the previous sections (with the exception of the original High Toxic strain, 14 × 24) are considered to be

primarily low or medium altitude ones. Work on the Molo station (8,300 ft.) this season gives promise of a good high altitude strain. One cross (127 × 481) combines vigorous flowering with high content. It yielded 1,407 lb. per acre in its second year. The mean content of the flower samples analysed was 2.37 per cent. This combination of yield and content represents a production of 33.3 lb. pyrethrins per acre, a very exceptional yield. It was considered that the performance of this cross warranted the immediate bulking of the parent clones and vegetative propagation of clones 127 and 481 has already begun with a view to planting a seed production plot.

A second cross (127 × 468) also gave a very good yield of pyrethrins but it will not be possible to produce seed of this cross in the near future owing to the fact that all the available plants of clone 127 are required for producing seed of 127 × 481.

Plant Breeding and Altitude.—The present range of altitude within which pyrethrum is grown commercially extends from below 7,000 ft. to above 9,000 ft. This represents a fairly considerable range of climate, particularly as regards temperature, and it is considered unlikely that the progeny from a single cross would ever prove completely satisfactory in all areas. Moreover there is much land around the present lower limit of pyrethrum cultivation which could be utilized profitably if a suitable low altitude strain could be found. The 188 × 214 cross grows well at 7,000 ft. but the lowest limit at which it can be grown successfully is not yet known.

These considerations have pointed to the advisability of carrying out the breeding work at a variety of altitudes and two new stations, which extend the altitude range in both directions, were started this year. The Marindas station, at 9,000 ft., should prove a valuable site for work on high altitude strains, the Rongai plots, at 6,500 ft., provide an opportunity for testing clones at a very low altitude.

Exchange of Seed.—In accordance with a scheme started in 1949, seed was received from Brazil and New Zealand. The latter is of particular interest since it represents crosses bred for resistance to root rot. It is hoped to test their resistance under Kenya conditions in due course.

Seed received previously from Kashmir, Belgian Congo and Japan was tested in variety trials.

Three strains were sent to Tanganyika for trial at Arusha and in the Southern Highlands.

Colchicine.—Trials of colchicine as a seed treatment did not give satisfactory results and the work was abandoned.

Routine Work.—Over 600 new selections were planted in progeny rows at the various stations and records kept of their performance. Thirty-eight new crosses were made and seedlings from earlier crosses were tested out in six variety trials.

Bud Disease

Spraying Trials.—Two plots of $\frac{1}{4}$ acre each on a farm in the Molo district were sprayed at monthly intervals with Perenox and Tulisan respectively. Sample lines of plants were counted at regular intervals in order to determine the number of diseased buds per 100 flowers picked. The results were as follows:—

Disease Rate Per Cent				
Perenox	..	..	..	10.0
Tulisan	..	..	..	17.3
Control	..	..	..	16.6

In addition to the above, a smaller, replicated trial was carried out at the Molo station to test the fungicides Parzate, Fermate, Zerlate and Dithane. The bud disease rate for the sprayed treatments varied between 2.4 and 4.7 per cent, the corresponding rate for the control was 2.7 per cent.

As in previous trials, this season's work has suffered from a lack of bud disease infection. On the Molo station, the incidence of disease was negligible and in the Perenox-Tulisan trial the amount of the disease was not great. The maximum difference between sprayed and control was a drop of 6.6 per cent in the disease rate in the Perenox trial. This difference is within the limits of experimental error.

Weeding Trial.—A small trial was carried out on plants of a single clone to test the effect, if any, of weeds on the incidence of disease. The weeds reduced the yield of the pyrethrum from 1,140 lb. per acre to 560 lb. per acre, but the weakening effect of weed competition did not affect the incidence of bud disease.

Co-operative Experiment.—This year 33 growers contributed postcard returns showing the results of weekly disease rate counts on plants of a single clone, established on different farms in the pyrethrum growing areas.

The mean disease rate for the year was 11.4 buds per 100 flowers picked. This is slightly higher than in 1949-50 when the rate was 8.7 per cent, but this is probably attributable to the fact that in 1949-50 the plants were in their first year and that bud disease does not usually attack plants in their first season so much. Field observations suggest that the general incidence of bud disease this year was considerably less than last year.

In the 1949 Annual Report, the results of the counts from districts east of the Rift Valley were contrasted with those made west of the Rift Valley. The former had an average disease rate of only 4.6 per cent as compared with 11.4 per cent for the latter and it was suggested that environmental influences, east of the Rift might be less favourable for the spread of the disease. The Nanyuki district, for example, with only three diseased buds for 1,446 flowers, had been particularly free from disease.

This year, the counts were studied in the same way with similar results. The incidence of disease west of the Rift Valley was about double that experienced east of the Rift and in the Nanyuki district there only one diseased bud for 4,854 flowers.

BUD DISEASE COUNTS, 1949-51

	1949/50			1950/51		
	No. fls.	No. dis. buds	Dis. per cent	No. fls.	No. dis. buds	Dis. per cent
East of Rift	12,379	568	4.6	40,169	3,442	8.6
West of Rift	18,470	2,106	11.4	20,403	3,435	16.8
TOTAL	30,849	2,674	8.7	60,572	6,877	11.4

Although Nanyuki was especially free from disease in both seasons, the smaller incidence of disease east of the Rift cannot be attributed entirely to the very low rates obtained in this district. If the Nanyuki records are excluded, the mean bud disease rate east of the Rift Valley was 5.2 per cent in the first season and 9.7 per cent in the second.

The results of this trial over two seasons, coupled with general field observations over a longer period, do provide evidence that environmental factors play their part in determining the amount of the disease, but little progress has been made in ascertaining the particular factors in the environment which are of importance in this respect.

Resistant Clones.—When bud disease first made its appearance, in 1946, it appeared that some plants were comparatively resistant. Five such plants together with five susceptible ones were selected in that year and disease counts have been carried out on these clones in every succeeding year. The resistant plants have maintained their superiority over the susceptible controls each season. This year,

the resistant clones averaged 5.9 per cent bud disease as compared with 13.8 per cent for the controls. At Ol Joro Orok, six clones which were chosen for extreme susceptibility in 1948, averaged 32 per cent bud disease this season as compared with 6 per cent for the controls.

These observations, carried out over a number of years, support the view that a final solution to the bud disease problem is possible through plant breeding. Previously resistant strains may eventually be attacked by some new form of the disease (as happens with rust resistant wheats) but no evidence of any such tendency has been observed so far.

General Experimental Work

Stripping Trial.—This trial was carried out at the request of the Pyrethrum Board in order to find the saving of labour which could be effected by various stripping treatments and to compare it with the loss of pyrethrins entailed by these methods of picking. "Stripping" was defined as the picking of all opened flowers irrespective of the stage of maturity. Stripping was tried at intervals of two, four and six weeks. The control consisted of selective picking (in the ordinary way) at two-weekly intervals, i.e. all the flowers were picked as near as possible to the fully-open stage.

In addition to the above, a mowing treatment was included. This consisted of cutting all the flowering stems at suitable intervals. On one-half of the plot, the flowers were allowed to dry on their stalks and the yield of pyrethrins from the resultant hay estimated. On the other half, the flowers and buds were combed from the stems whilst fresh and the weight of pyrethrins estimated in the flowers and buds only.

As the trial involved the estimation of labour requirements, comparatively large plots were used so that the various field operations could be timed accurately. Each plot was half an acre in area and the whole trial, consisting of five unreplicated plots, covered an area of $2\frac{1}{2}$ acres. Mr. E. J. Radcliffe kindly loaned part of a field of the High Toxic strain (14×24) in its second season for the trial and acknowledgments are gratefully made to him for his assistance.

Before the trial commenced it was confidently expected that the losses in pyrethrins consequent on stripping would be very considerable indeed. Past experience had shown that immature flowers were not only smaller than fully mature ones but contained substantially less pyrethrins. The various stripping treatments would contain varying proportions of immature flowers and it was thought that they would suffer accordingly. It therefore occasioned considerable surprise to find that during the first half of the season (mid-June to the end of August) the stripping treatments had actually produced slightly more pyrethrins per acre than the selectively picked control. During the second half of the season, the stripping treatments lost ground as compared with the control and over the season as a whole, the selectively-picked control yielded the biggest weight of pyrethrins although the difference between it and the stripping treatments was very much less than had originally been expected.

FINAL RESULTS OF MAIN STRIPPING TRIAL

	2 weekly stripping	4 weekly stripping	6 weekly stripping	2 weekly picking
Dry fls. lb./acre	739.4	725.0	666.8	762.4
Av. pyrethrins per cent	1.96	1.93	1.92	2.00
Pyrethrins lb./acre. . . .	14.465	14.118	12.735	15.228
	Sh.	Sh.	Sh.	Sh.
Gross value p.a.*	2,170	2,118	1,910	2,284
Cost Picking p.a.†	95	83	76	110
Nett value p.a.	2,075	2,035	1,834	2,174

*Calculated at Sh. 150 per lb. pyrethrins.

†Calculated at Sh. 1 per boy/day.

The savings in labour costs due to stripping were small compared to the value of the pyrethrins lost. Thus the saving in labour costs obtained by six-weekly stripping was only Sh. 34 per acre whereas the corresponding decrease in yield of pyrethrins was equivalent to a loss of Sh. 374.

The mowing treatment was very much worse than any of the stripping treatments. The combed flowers and buds yielded 5.7 lb. per acre pyrethrins and the pyrethrum hay totalled 5.9 lb. per acre.

The surprisingly good performance of the stripping treatment led to the carrying out of a small confirmatory trial on the Molo station, using the same strain. This trial gave roughly similar results and it began to be suspected that there might be some peculiarity in the strain used. Further study showed that immature flowers from clone 24 (one of the parents of 14 × 24) had abnormally high contents and that this abnormality was shared by plants from the 14 × 24 cross but by none of the other clones and crosses tested in this way. It therefore appears likely that the results of the stripping trial given above are only applicable to the 14 × 24 strain and that stripping would have given worse results if some other cross had been used in the trials.

The problem of inducing African labour only to pick flowers at the optimum maturity stage is one which is well known to every pyrethrum grower. The behaviour of clone 24 and the cross 14 × 24, suggests the possibility of breeding strains which would not need such a stringent supervision of the picking process.

Rotation Trials.—The portion of the larger rotation trial at Ol Joro Orok which was planted in 1947 completed its first three-year cycle in early 1950. It was evident that the cropping treatments of the previous three years had a marked effect on the soil. Plots which had been under pyrethrum for three years were far less capable of absorbing water than those which had been resting under grass. There was a considerable run-off of surface water from the pyrethrum land even after a shower of moderate intensity, the soil had a comparatively smooth, shiny surface after rain and was very erodable. The old grass land, on the other hand, absorbed moisture easily, had a rougher more puffy surface and did not erode. Land which had been under wheat was intermediate in appearance.

Chemical and physical analysis showed that the soil which had been under grass for three years had a better structure, was richer in nitrogen and stood at a higher level of general fertility (as measured by the conductivity of the soil after prolonged standing in contact with aerated water) than the soil which had been cropped with pyrethrum.

Some of these plots were planted with pyrethrum this year; but in spite of the improved status of the soil which had rested for three years under grass, no increase in the yield of pyrethrum was obtained. Pyrethrum, replanted on old pyrethrum land without any fertilizer, yielded 163.5 lb. per acre as compared with a yield of 161.8 lb. per acre from pyrethrum planted after grass. The grass ley had been grazed by sheep but had not had any fertilizer dressing. Apparently the soil deterioration consequent on continuous pyrethrum cultivation has not yet been sufficient to cause a falling off of yields. This long-term trial is still in its early stages and it will be several years before it can yield complete results. In the meantime, information of interest is accumulating year by year.

A smaller rotation trial which was started at Ol Joro Orok in 1946, was planted entirely to wheat this season with the object of comparing wheat on old grass land with wheat on old pyrethrum land. Part of the wheat established on grass land received a top dressing of 80 lb. per acre sulphate of ammonia, 44 days after planting.

Sample rows of plants were uprooted 79 days from planting and analysed for protein. The results showed that the wheat plants on old grass land without added nitrogen had very much less protein than the wheat on pyrethrum land or on grass land which had received a top dressing of nitrogenous fertilizer.

When the plots were harvested, however, the treatments with the higher protein analyses did not yield the most grain. The wheat on old grass land without added nitrogen yielded best; the fertilized grass land and the old pyrethrum land yielded significantly less.

WHEAT YIELDS FROM SMALLER ROTATION TRIAL, OL JORO OROK, 1950-51

	Grass Land No. N	Grass Land N. added	Pyrethrum Land No. N
Fresh Wt. plants tons/acre..	8.28*	10.11*	10.58
Protein per cent ..	9.30†	11.50	11.30†
Wt. protein lb./acre ..	285.6†	456.8†	467.2
Wt. grain lb./acre ..	1580.5*	1301.4*	1115.4

*Significant $P=0.05$.

†Significant $P=0.001$.

It is possible that the lower grain yields in the higher protein treatments were due to increased lodging of the crop, but lodging was not very severe. The trial is being continued to see if there is any residual effect.

A green manure trial at Molo, designed to test the effect of one year of lupins and sunflowers as green manures between successive crops of pyrethrum indicated that the green manures had raised the yield of the succeeding crop of pyrethrum in its second year from 886.0 lb. per acre to 1,034.1 lb. per acre, a significant increase. The control treatment in this trial consisted of one year of wheat fertilized with 60 lb. per acre of triple superphosphate. The green manure crops also received 60 lb. per acre of triple superphosphate.

Oxidase and Pyrethrins Content.—Some results obtained by Lt.-Col. L. A. Notcutt, in Tanganyika, using a rough quantitative test for oxidase, suggested that there might be an association between the amount of oxidase in pyrethrum flowers and their pyrethrins content. A trial was accordingly carried out at Ol Joro Orok on a series of 43 clones, each of which was tested for oxidase and pyrethrins. The value of r , the correlation coefficient, was + 0.2422; this was not significant.

A parallel trial was carried out on a single clone which was tested for oxidase and pyrethrins on six occasions. The pyrethrins analyses remained fairly constant, the standard error of the mean being ± 1.7 per cent. The oxidase contents, on the other hand, revealed significant differences in between occasions, the standard error of the mean being ± 12.8 per cent. The oxidase test used in these experiments consisted of standing the fresh flowers for two hours in a mixture of starch and potassium iodide and expressing the oxidase content in terms of the volume of a standard solution of sodium thiosulphate required to reduce the blue colour. This method was not found to be very accurate, nevertheless the variations between occasions in this trial were significantly greater ($P = 0.001$) than could be attributed to the inaccuracies of the test.

It was concluded that there was no association between pyrethrins content and oxidase content.

Spacing Trials.—The question of planting spacings has been investigated rather fully in previous years but it was felt desirable in 1949 to plant two small supplementary trials at Molo and Subukia comparing double rows (1 ft. by 1 ft. with 3 ft. between the double rows) with a triple row spacing (3 rows planted at 1 ft. by 1 ft. with 3 ft. between the triple rows). There was no significant difference in yield at either station in 1949-50 and none in 1950-51. As in previous trials, it was found that the closer spacings suffer comparatively severe losses in stand due

to the increased competition between plants and that populations of about 22,000 plants per acre appear to be the most satisfactory under Kenya conditions. The double-row system in the above trials has 21,780 plants per acre; there are 26,136 plants per acre in the triple-row planting system.

Pyrethrins Content and Rainfall.—In last year's Report, it was stated that a study of the analyses of growers' flowers had revealed a significant association between pyrethrins content and the altitude at which the crop was grown. It was not known, however, what environmental factor included under the general heading "altitude" was responsible for the changes in content.

Rainfall records over a 12-month period were collected for 70 stations distributed throughout the pyrethrum growing areas and the rainfall totals compared with altitude. No correlation was found between the two factors. Similarly there was no connexion between rainfall totals over the period of a year and pyrethrin contents for the same period.

The rainfall figures were then split into monthly periods and compared with pyrethrin contents. The results of this study suggest that there is a correlation between rainfall and pyrethrins content where the monthly rainfalls range from about 1 in. to 4 in. It would appear that if the rainfall is less than 1 in. per month, a fraction of an inch more or less cannot affect the pyrethrins content appreciably; it evaporates quickly and does not penetrate the soil deeply. If the monthly rainfall is more than 4 in. there is ample moisture in any case.

Trace Elements.—In the 1949 Report, some small trials designed to test the effect, if any, of manganese and magnesium on pyrethrins content were described. No positive results were obtained. This year, a further magnesium trial was carried out at the Molo station where a magnesium deficiency has been demonstrated on fruit trees. The magnesium had no beneficial effect on yield or content.

Weedkillers.—Various weedkillers have been tried on pyrethrum in the past but results have been generally unsatisfactory. This year two more substances were tried—pentachloral-phenol and Tractor Vapourizing Oil. Both proved unsuitable since they caused too much damage to the pyrethrum.

Seed Trials.—Various small trials were carried out in collaboration with the Senior Plant Pathologist to test the effect of seed dressings. These trials are not yet complete.

A rate of seeding trial in the nursery indicated that for seed with a germination of 40 per cent, the optimum seeding rate was about 1 oz. per 225 sq. ft.

Pests and Diseases.—There is little to report under this heading. Beyond the usual few cases of root rot, eelworm, thrips, etc., no trouble was experienced. A separate account of bud disease has been given above.

Publications.—A booklet entitled "Pyrethrum Breeding in Kenya" was prepared by the Senior Agricultural Officer and published by the Pyrethrum Board.

Acknowledgments

Thanks are gratefully rendered to members of the Pyrethrum Research Advisory Committee for their unfailing assistance during the year. Mr. N. H. Hardy, Executive Officer of the Pyrethrum Board, has rendered every possible assistance and this opportunity is taken of thanking him and members of the Pyrethrum Board for their help.

E. W. GADDUM,
Senior Agricultural Officer, Pyrethrum.

APPENDIX

METEOROLOGICAL RECORDS

Molo

Month	Rain inches	Humidity per cent 8.30 a.m.	Max. Mean F.	Min. Mean F.
January	0.32	70	72.1	42.2
February	0.25	67	74.0	41.0
March	2.66	75	71.6	44.1
April	7.91	87	69.4	46.2
May	3.38	84	68.0	44.2
June	4.13	85	66.7	46.0
July	8.18	89	63.4	43.8
August	3.74	84	66.0	44.2
September	5.21	78	67.3	43.6
October	1.99	74	69.5	43.6
November	0.93	78	68.7	43.5
December	1.06	73	71.0	43.1
	39.76	79	69.0	43.8

Ol Joro Orok

Month	Rain inches	Humidity per cent 8.30 a.m.	Max. Mean F.	Min. Mean F.
January	0.85	68	72.6	42.9
February	0.05	60	74.6	41.5
March	1.04	71	73.0	45.5
April	5.50	74	71.1	45.5
May	2.28	83	69.8	43.6
June	2.56	82	68.6	45.4
July	7.43	85	65.5	44.5
August	5.84	86	66.0	43.9
September	5.28	80	68.7	41.9
October	1.40	69	70.4	44.5
November	0.93	73	69.6	45.9
December	0.64	67	71.4	42.9
	33.80	75	70.1	44.0

Subukia

Month	Rain inches	Humidity per cent 8.30 a.m.	Max. Mean F.	Min. Mean F.
January	0.42	59	76.6	48.5
February	—	54	78.3	49.0
March	1.24	64	77.4	49.6
April	3.73	67	73.5	50.4
May	5.22	72	71.9	48.9
June	3.38	75	72.2	50.1
July	6.25	79	70.5	48.8
August	6.13	78	70.7	48.9
September	13.26	72	71.9	47.3
October	3.43	72	74.1	44.4
November	0.76	70	73.4	49.2
December	0.37	59	76.2	49.8
	44.19	68	73.9	48.7

ANNUAL REPORT OF THE AGRICULTURAL OFFICER IN CHARGE, HIGH LEVEL SISAL RESEARCH STATION, THIKA, FOR 1950

General

METEOROLOGICAL

The rainfall at the station, although higher than that of 1949, was below normal. The low rainfall was due to the failure of the short rains at the end of the year.

The rainfall for the year was:—

January	..	..	0.59" in 2 days.
February	..	..	Nil.
March	..	..	6.36" in 13 days.
April	..	..	9.08" in 16 days.
May	..	..	3.17" in 9 days.
June	..	..	0.72" in 4 days.
July	..	..	0.20" in 3 days.
August	..	..	1.13" in 5 days.
September	..	..	Nil.
October	..	..	0.88" in 3 days.
November	..	..	4.19" in 13 days.
December	..	..	0.15" in 3 days.
Total	..	..	26.47" in 71 days.

The average rainfall for the 10 years 1941–50 is 31.44".

GRASS

Molasses grass (*Melinis minutiflora*) and *Eragrostis curvula* have shown great promise in plots at the Station, and Rhodes grass (*Chloris gayana*) is doing well in the seed production area. The distribution of planting material is being encouraged as it is anticipated that grass leys will play an important part on sisal estates in the future.

Investigational Work in Progress

CUTTING TRIAL

Object.—To investigate the effect of cutting on the sisal plant.

Date of Commencement.—March, 1941.

Spacing.—12 ft. by 3 ft. (1,210 plants per acre).

Treatments.—Commencement of cutting: 3½ years, 4 years and 4½ years. Intervals between cuts: 6 months, 12 months, 18 months. Intensity of cut: light, leaving 36 leaves after each cut; heavy, leaving 12 leaves after each cut.

Design.—3 by 3 by 2 factorial with 4 replications.

This trial was cut according to programme in February and August, 1950.

A summary of results can best be expressed in the following table.

	FIRST CUT AT			INTERVALS BETWEEN CUTS			INTENSITY OF CUT	
	3½ yrs.	4 yrs.	4½ yrs.	6 mts.	12 mts.	18 mts.	Heavy	Light
No. of leaves lost over 24 in. ..	5.6	12.2	23.8	13.7	13.6	14.3	14.4	13.3
No. of leaves cut per plant	232.3	208.2	194.5	216.9	211.7	206.4	214.8	208.5
Wt. of leaves per plant ..	357.8	361.4	368.1	360.5	359.7	367.2	353.8	371.1
Tons of unbrushed fibre per acre ..	6.54	6.04	5.90	6.24	6.08	6.16	6.01	6.31
Poling per cent ..	78.5%	89.8%	95.8%	73.5%	92.9%	97.5%	76.2%	99.8%

Statistical analysis of the yield of line fibre shows that a light cut is significantly better than a heavy cut and that an early first cut at $3\frac{1}{2}$ years is significantly better than the two later cuts. There is no significant difference between the two later treatments nor between the three different intervals of cuts.

Thus it can be stated that an early cut is desirable and a light cut is essential to increase yields.

SPACING TRIAL

Object.—To investigate the effect of various spacings on sisal yields.

Date of Commencement.—February, 1941.

Method of Cutting.—First cut at $3\frac{1}{2}$ years followed by cuts at yearly intervals.

Design.—Six randomized blocks.

The following table gives a summary of yield figures, etc., up to September, 1950:—

Spacing Population	15×4 ft. 726	11×4 ft. 990	18×3½ ft. 1013	12×3 ft. 1210	15×2 ft. 1452	22×2 ft. 1613	11×2½ ft. 1760	10×2 ft. 2178
No. of leaves cut per plant	228·9	228·6	228·4	230·1	223·5	222·4	210·5	215·7
Wt. of leaves cut per plant	398·2	367·5	376·0	376·3	368·1	353·5	334·6	336·5
Tons of unbrushed fibre per acre	4·24	5·60	5·73	6·86	8·42	9·54	8·29	11·31
Poling per cent	100·0	100·0	100·0	100·0	87·5	91·7	71·9	81·3
Age now or at 100 per cent poling	7½ yrs.	8 yrs.	9½ yrs.	9 yrs.	9½ yrs.	9½ yrs.	9½ yrs.	9½ yrs.
Yields per acre per year of cycle (tons)	0·57	0·70	0·60	0·76	0·89	1·00	0·87	1·19

Under field conditions it is most likely that all the spacings would have been cut out for replanting at this or an earlier stage, and under such circumstances the yields of fibre from the four highest populations, which have not yet completely poled out, would be slightly higher than the figures given above.

There is no doubt that higher populations must become general practice to ensure higher yields. The very popular spacing in Tanganyika of 4 m. by 1 m. by 1 m. has, in a modified form of 13 ft. by 3 ft. by 2 ft. 9 in. staggered, been used in all field trials laid out at the Station during 1950. With this spacing the population of 1,980 plants per acre is well above the average used in Kenya. The appearance of these areas is very pleasing and, provided that most of the couch grass has been removed before planting, this spacing does not present any apparent drawbacks.

PLANTING METHOD TRIAL

Object.—To compare yields when using old suckers from overgrown fields, young suckers from two-year fields and nursery plants produced from bulbils.

Date of Commencement.—24th April, 1949.

Spacing.—12 ft. by 2ft. 6 in. (1,452 plants per acre).

Treatments.—Materials: Old Suckers, young suckers, nursery plants. Depth of planting: Deep, shallow.

Design.—6 by 6 Latin square.

At the moment there appears to be no significant difference in leaf count between nursery plants and young and old suckers, but shallow planting is preferable to deep planting.

The nursery plants and old suckers have, as anticipated, produced longer leaves, but early differences in leaf length between deep and shallow planting appear to even up.

NURSERY MULCHING TRIAL

Object.—To investigate the effect of a heavy application of fresh sisal waste from wet decortication on the growth rate of bulbils.

Date of Commencement.—21st April, 1949.

Planting Material.—Bulbils spaced 2 in. by 9 in.

Treatment.—Mulch applied 25th May, 1949, at the rate of 95 tons of wet waste per acre. The waste which was obtained from the flume trench, contained approximately 89 per cent moisture by sun-drying.

Design.—Ten replications of each treatment randomized.

The plants were lifted on 28th March, 1950, after 11 of the driest months recorded at this Station, and the average weight of the plants after cutting off the root system was:—

Mulched	2.81 lb. per plant.
Unmulched	1.91 lb. per plant.

There was thus a very marked response to mulching.

NURSERY MANURIAL TRIAL

Object.—To investigate the effect of certain fertilizer applications and spacings on the growth rate of bulbils.

Date of Commencement.—25th November, 1948.

Treatments.—Manurial applications:—

Control	Nil.
Well-rotted Sisal Compost	18 tons per acre.
Sisal Bole Ash	17 cwt. per acre.
Sulphate of Ammonia	300 lb. per acre.
Sisal Compost and Sulphate of Ammonia	Rates of applications as above.
Sisal Bole Ash and Sulphate of Ammonia	Rates of applications as above.

Design.—6 by 6 Latin square using split plots for wide spacing (2 ft. by 9 in. with 29,040 plants per acre) and close spacing (1 ft. by 9 in. with 58,080 plants per acre).

The plants were lifted on 28th March, 1950, 16 months after planting, and the roots were cut off before weighing the plants.

A record of the average plant weight is given in the following table:—

	Control	Ash	Nitrogen	Compost	Ash and Nitrogen	Compost and Nitrogen
	lb.	lb.	lb.	lb.	lb.	lb.
General Mean of all recorded plants	1.58	1.84	1.85	2.55	1.80	2.92
		The effect of spacing was as follows:—				
Wide Spacing 2 ft. × 9 in.	2.08	2.46	2.39	3.37	2.40	4.13
Close Spacing 1 ft. × 9 in.	1.32	1.53	1.59	2.14	1.49	2.31

NURSERY MANURIAL AND MULCHING TRIAL

Object.—To compare the effects of fertilizers and waste, dug in and as a mulch, on the growth rate of bulbils.

Date of Commencement.—28th November, 1950.

Spacing.—2 ft. by 9 in.

Treatments.—

- 300 lb. of Sulphate of Ammonia per acre.
- 180 lb. of Double Superphosphate per acre.
- 120 lb. of Muriate of Potash per acre.
- 30 tons well-rotted Sisal Waste per acre, dug in.
- 30 tons well-rotted Sisal Waste per-acre as mulch.

Design.—2⁵ factorial.

FERTILIZER TRIAL

Object.—To investigate the possible effect on the growth rate of sisal plants by applying artificial fertilizers and/or sisal waste.

Date of Commencement.—16th March, 1950.

Spacing.—13 ft. × 3 ft. × 2 ft. 9 in. (1,980 plants per acre).

Treatments.—

- (1) Sulphate of Ammonia applied at the rate of 388 lb. per acre in each of the first four years of the cycle.
- (2) Double Superphosphate, applied in shallow trenches under the plants a week before planting at the rate of 260 lb. per acre.
- (3) Muriate of Potash applied at the rate of 395 lb. per acre for the first year and 300 lb. per acre during each of the next three years.
- (4) Agricultural (90 per cent CaCO_3), broadcast over the whole treated area at the rate of 2 tons per acre a month before planting.
- (5) Sisal Waste, as fresh sisal waste taken straight from a Corona decorticator, decorticating dry. The waste was applied at the rate of 107 tons wet waste per acre and dug in one month before planting in strips covering an area 4 ft. each side of the double rows.

Design.— 2^5 factorial design.

This trial is as yet too young to give any indication of results, but it would appear that Sisal Waste and/or Double Superphosphate have so far stimulated growth more than the other fertilizers.

SISAL WASTE AND MINERAL TRIAL

Object.—To compare the effect of different methods of applying fresh sisal waste, waste reinforced with artificial fertilizers and fertilizers alone.

Date of Commencement.—17th March, 1950.

Spacing.—13 ft. × 3 ft. × 2 ft. 9 in. (1,980 plants per acre).

Treatments.—

	Fresh Sisal Waste	Sulphate of Ammonia	Double Super Phosphate	Muriate of Potash	Agric. Lime (Ca CO_3 96%)
	tons	lb.	lb.	lb.	tons
Control	Nil	Nil	Nil	Nil	Nil
Waste half dug in and half as mulch . . .	107	Nil	Nil	Nil	Nil
Waste all dug in . . .	107	Nil	Nil	Nil	Nil
Waste all as mulch . . .	107	Nil	Nil	Nil	Nil
Waste half dug in and half as mulch with minerals added . . .	107	390	65	325	0.42
Waste all dug in with minerals added . . .	107	390	65	325	0.42
Waste all as mulch with minerals added . . .	107	390	65	325	0.42
Minerals only	Nil	1,560	260	1,300	2.0

- (1) The waste, Lime and Superphosphate were applied before planting as in the Fertilizer trial. Sulphate of Ammonia applied with waste at the rate of 129 lb. per acre for first year and 87 lb. per acre during each of the next three years. Applied without waste at the rate of 522 lb. for the first year and 346 lb. per acre during each of the next three years.
- (2) Muriate of Potash applied with waste at the rate of 130 lb. per acre the first year and 65 lb. during each of the next three years. Applied without waste at the rate of 520 lb. per acre for the first year and 260 lb. during each of the next three years.

Design.—Four randomized blocks of eight plots.

This trial is too young to show results.

CULTIVATION TRIAL

Object.—To investigate the effect on the soil and sisal plants of continuous clean weeding by mechanical means as against restricted weeding with and without a controlled grass cover in the area between sisal lines.

Date of Commencement.—1st November, 1950.

Spacing.—13 ft. by 3 ft. by 2 ft. 9 in. (1,980 plants per acre).

Treatments.—

- (1) Grass strip slashed frequently to keep the grass low.
- (2) Grass strip cut periodically and the cut grass used as mulch round sisal plants.
- (3) Clean weeded by frequent discing for the first three years, then as (1).
- (4) Clean weeded by frequent discing for the first three years, then discing twice a year.
- (5) Discing twice a year for the whole cycle.
- (6) Clean weeding by frequent discing for the whole cycle.

The trial incorporates the above treatments with sisal planted on the flat and on ridges. The grass cover is obtained by sowing Rhodes Grass (*Chloris gayana*) in 6 ft. wide strips between the double-rows, at the rate of 19 lb. of seed per acre of the area sown.

Design.—Four randomized blocks each of 12 plots.

This trial is too young to show results.

PLANTING MATERIAL TRIAL

Object.—To investigate the possibility of obtaining greater efficiency by using larger nursery plants and an earlier first cut than is normal practice in Kenya.

Date of Commencement.—3rd November, 1950.

Spacing.—13 ft. by 3 ft. by 2 ft. 9 in.

Treatments.—

Planting material: Nursery plants, 9 in. high, weight about 1 lb.; nursery plants, 15 in. high, weight 3–3½ lb.; nursery plants, 21 in. high, weight 6½–7 lb.

Age at first cut: Early, normal, late (to be decided at a later date).

Intensity of cut: Heavy, leaving 12 leaves after cutting; medium, leaving 24 leaves after cutting; light, leaving 36 leaves after cutting.

Since the best time to begin cutting and the optimum severity of cutting may well depend on the size of the planting material used, all the combinations of the above factors have been incorporated in this trial, which has been planted on the flat.

Design.—3³ factorial, two replications confounded.

BULBILS, NURSERY PLANTS AND SUCKER TRIAL

Objects.—To compare bulbils planted *in situ* in the field with nursery plants and suckers, and further to compare flat and ridged planting on red soils.

Date of Commencement.—7th November, 1950.

Spacing.—13 ft. by 3 ft. by 2 ft. 9 in.

Treatments.—

(1) Bulbils of average weight, 3 oz., planted *in situ* in fields.

(2) Nursery plants 15 in. high, weight 3–3½ lb.

(3) Suckers from old areas, 25 in. high, weighing 10–12 lb.

(4) Ridged versus flat.

Design.—6 by 6 Latin square.

External Trials

The object of five of the external trials is to ascertain variations in growth rates in the various districts using different spacings and cutting treatments.

Treatments for all the trials are as follows:—

Spacings: 11 ft. between single lines; 14 ft. between single lines; 18 ft. by 3 ft. double-row planting.

Populations: 1,200 plants per acre; 1,600 plants per acre; 2,000 plants per acre.

Age at first cut: Early; normal; late.

Interval between cuts: 6 months; 12 months; 18 months.

Design.—3⁴ factorial experiment arranged in 9 by 9 quasi Latin square.

(1) RUIRU TRIAL (BLACK COTTON SOIL RIDGED)

Locality.—Juja Farm, Ltd., Ruiru.

Date of Commencement.—16th March, 1948.

Summary of Results up to 1st December, 1950:—

Population	LEAF COUNT Space between rows				LEAF LENGTH IN CMS. Space between rows			
	11 ft.	14 ft.	18 × 3ft.	Average	11 ft.	14 ft.	18 × 3ft.	Average
1,200	82.9	81.2	89.2	84.4	80.1	80.5	86.0	82.2
1,600	76.6	72.7	77.8	75.7	76.1	74.7	77.3	76.0
2,000	74.8	69.9	75.3	73.4	76.7	74.5	76.4	75.9
Average ..	78.1	74.6	80.7	77.8	77.6	76.6	79.9	78.0

(2) TRANS NZOIA TRIAL

Locality.—Ziwa Estate, Ltd., Hoey's Bridge.

Date of Commencement.—10th April, 1948.

Summary of Results up to 1st December, 1950:—

Population	LEAF COUNT Space between rows				LEAF LENGTH IN CMS. Space between rows			
	11 ft.	14 ft.	18 × 3ft.	Average	11 ft.	14 ft.	18 × 3ft.	Average
1,200	95.0	92.8	90.6	92.8	73.0	73.8	71.9	72.9
1,600	88.4	88.7	87.6	88.2	71.8	74.4	72.0	72.7
2,000	85.0	82.4	86.8	84.7	69.9	71.9	72.7	71.5
Average ..	89.4	87.9	88.3	88.5	71.6	73.4	77.0	72.4

(3) KAMPI-YA-MOTO TRIAL

Locality.—Alphega Estate, Kampi-ya-Moto.

Date of Commencement.—23rd October, 1948.

Summary of Results up to 1st Decemeber, 1950:—

Population	LEAF COUNT Space between rows				LEAF LENGTH IN CMS. Space between rows			
	11 ft.	14 ft.	18 × 3ft.	Average	11 ft.	14 ft.	18 × 3ft.	Average
1,200	74.2	71.0	64.8	70.0	76.2	71.0	67.5	71.6
1,600	70.7	68.8	67.3	68.9	71.0	73.6	71.0	71.9
2,000	66.7	62.8	61.6	63.7	69.3	68.8	64.9	67.6
Average ..	70.5	67.5	64.6	67.5	72.2	71.1	67.8	70.4

(4) THIKA TRIAL

Locality.—Anglo-French Sisal Estate, Thika.

Date of Commencement.—17th November, 1948.

Summary of Results up to 1st December, 1950:—

Population	LEAF COUNT Space between rows				LEAF LENGTH IN CMS. Space between rows			
	11 ft.	14 ft.	18 × 3ft.	Average	11 ft.	14 ft.	18 × 3ft.	Average
1,200	75.0	72.1	68.8	72.0	78.6	76.1	73.5	76.1
1,600	71.0	66.2	63.8	67.0	76.0	74.6	69.3	73.3
2,000	68.4	58.5	64.1	63.7	72.8	70.5	71.0	71.4
Average ..	71.5	65.6	65.6	67.5	75.8	73.7	71.3	73.6

(5) KIBWEZI TRIAL

Locality.—Dwa Plantations, Ltd., Kibwezi.

Date of Commencement.—21st October, 1949.

Summary of Results up to 1st December, 1950:—

Population	LEAF COUNT Space between rows				LEAF LENGTH IN CMS. Space between rows			
	11 ft.	14 ft.	18 × 3ft.	Average	11 ft.	14 ft.	18 × 3ft.	Average
1,200	30.1	28.3	28.5	29.0	52.7	52.1	52.1	52.3
1,600	31.7	30.0	26.4	29.4	52.6	53.1	52.4	52.7
2,000	28.7	28.9	29.7	29.1	52.5	53.0	52.5	52.6
Average ..	30.2	29.1	28.2	29.2	52.6	52.7	52.3	52.5

(6) RIDGING VERSUS FLAT TRIAL (TRANS NZOIA)

Object.—To compare the relative merits of planting sisal on the flat and on ridges on the red soils in the Trans Nzoia area.

This trial is also being used as a uniformity trial.

Locality.—Adjacent to the main trial at Ziwa Estate, Hoey's Bridge.

Date of Commencement.—11th April, 1948.

So far there appears to be no difference between the growth rates of plants on the flat and on ridges.

(7) FLAT VERSUS RIDGED WITH SUBSOIL TREATMENT TRIAL (KAMPI-YA-MOTO)

Object.—To ascertain whether subsoiling or ridging will improve the rate of growth on the sandy soils of Kampi-ya-Moto area.

Locality.—Adjacent to the main trial on Alphega Estate, Kampi-ya-Moto.

Date of Commencement.—24th October, 1948.

The difference between the control, ridged, subsoiled and subsoiled and ridged plots are negligible.

(8) BANDING DISEASE TRIAL

Object.—To ascertain whether Muriate of Potash will stop the development of leaves affected by Banding Disease and the amount of fertilizer required for the control of the disease.

Locality.—Fort Hall district.

Date of Commencement.—Fertilizer applications were made on 17th November, 1949, to two-year-old sisal in a field affected by the disease.

Treatments.—Applications of Muriate of Potash: Nil, 110 lb., 220 lb., 330 lb., 440 lb. per acre.

Design.—5 by 5 Latin square.

The applications of Muriate of Potash do not seem to affect the rate of leaf production or length of leaves. Fewer diseased leaves have been produced in the plots which have received Muriate of Potash and the application of 110 lb. of the fertilizer appears to be less effective than the three higher rates of application.

(9) LEAF TIP DIE-BACK TRIAL

Object.—To ascertain whether applications of Agricultural Lime, Double Superphosphate, Silica Phosphate, single or in combinations will prevent the drying up of the leaf tips.

Locality.—On red loam soil in the Thika District.

Date of Commencement.—Fertilizers were applied on 8th March, 1950, in a field planted in August, 1947.

Treatments.—

Control	.. ..	Nil.
Ca	.. ..	2 tons CaCO_3 (96 per cent) per acre.
P	.. ..	250 lb. Double Superphosphate per acre.
S	.. ..	500 lb. Silica Phosphate per acre.
Ca+S	.. ..	Rates as above.
Ca+P	.. ..	Rates as above.

Design.—Three blocks of six randomized plots.

It is still too early to obtain definite results from this trial, but from the count of diseased leaves produced since application of the fertilizers, Silica Phosphate alone or with Lime seem to have very little effect, whereas Lime and Superphosphate, alone or in combination seem to have reduced the development of diseased leaves.

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